BOARD OF AGRICULTURE AND FISHERIES.

LEAFLETS

(Nos. 201 to 300).

THIRD EDITION.

WITH INDEX.

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Leaflet No. 201.

BOARD OF AGRICULTURE AND FISHERIES.

The Marketing of Poultry.

The demand for high-class poultry in Great Britain has greatly increased in recent years. Even in those markets in which the trade is chiefly a lower class one, it is noteworthy that there is a steadily increasing demand for finer quality fowls. As it is to be anticipated that this demand will continue to grow, poultry keepers will be well advised to turn their attention to this branch of their business, especially as they need not here fear any very serious competition from American, Russian and other Continental supplies.

Markets.

London.—The best markets in the country are those of Leadenhall and Smithfield, in London, but to obtain good prices the birds sent up must be very carefully fed and well finished. At these markets there is an almost unlimited demand for the very best quality of fattened birds weighing from 4 to 5 lb. and over, according to the season of the year. Where disparity in prices in the same consignment occurs it will frequently be found to be due to variation in size and quality. During the spring there is also a good demand for young chickens, weighing 2½ to 3 lb., unfattened but well fed, and a more limited demand for milk chickens, weighing about 12 ozs.

In the London markets the best season for large well-fattened fowls is from November to February, and from March to July for moderate sized birds. Ducklings sell fairly well all the year round, but best from February to June; there is a fairly good demand for fat ducks in the autumn and winter; goslings in May and June and at Michaelmas; fat geese at Christmas and for a short time afterwards, but their season is limited; turkeys fetch high prices according to size, appearance, and straightness of breast bone, for a short time before and after Christmas. At Smithfield (Central Market), Tuesdays, Thursdays, and Fridays are the best days for selling; at Leadenhall, Mondays, Wednesdays, Thursdays and Saturdays.

Provincial Markets.—Information as to prices in a large number of the best markets will be found in the Weekly Return of Market Prices issued by the Board of Agriculture and Fisheries.*

Killing.

All birds should be starved for twenty-four hours before killing in order that the crop and intestines may be emptied of food. A great amount of loss arises from neglect of this precaution. Unless the purchaser wishes the birds to be killed in a special way they should be killed by dislocating the neck just where it joins the head. Dislocation of the neck, when properly performed, results in the breaking of the jugular vein, and the blood drains completely from the body veins into the neck. A few salesmen like the fowls to be bled by a knife passed through the slot in the roof of the mouth. Bleeding, however, is apt to spoil the feathers and soil the packing, and so reduce the price of the whole consignment.

Plucking.

As a badly-plucked bird is of little value except among the poorer class of buyers, plucking should be carried out carefully. Birds should always be plucked while the body is still warm, as the feathers then come out more easily and there is less danger of tearing the skin. If this is not possible the operation should be postponed until the bird is quite cold, that is, at least twenty-four hours after killing.

In plucking, fowls should be held by the legs, with the head hanging downwards; turkeys and geese should be suspended by the legs to a cord hung from the roof. The feathers should be drawn by a firm yet gentle pull towards the head.

The plucking should begin at the tail and be continued in the following order ; back, neck, wings, sides, legs, and breast. It is unwise to start with the breast, as the surface veins in that part of the body are the last to drain dry and the carcase will be discoloured if any of these veins are ruptured. The breast bone should not be broken.

Fowls must be plucked clean except for the head and half the neck ; turkeys must also be plucked clean, except for the feathers on the outer ends of the wings and the tail ; in ducks and geese the wings and half the necks must be left unplucked.

The legs and feet of all birds should be quite clean.

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* **This return is issued free of charge to farmers and others interested and may be obtained on application to the Board's Office at 3, St. James's Square, London, S.W.**

Shaping.

When plucking has been completed, the fowls should be singed and packed tightly breast downwards in a shaping trough, with the heads hanging over the front board. They are left in this position for the flesh to set and cool. A long narrow board should then be placed along their backs and the board weighted, a common method being to use a 9-lb. brick to every two birds. In placing the birds in the trough, the stern is pushed hard up against the back board, thus giving the birds a shortened appearance. Shaping troughs, which consist of two boards joined together somewhat in the shape of a V, are usually made to hold eight or twelve birds.

For some markets the birds are required to be tied down in Devonshire fashion. This is done as follows:—

Immediately after plucking the back, the claws are removed and a gash is made on each side of the middle toe. A short string is then tied to each of these toes, the legs are drawn forward and inwards, and the two strings are tied together behind the neck, and pulled tight. A second and rather longer string is now tied round the hocks, crossed on the vent, and fastened at the back of the tail, again pulling tight. Finally, the wings are tucked in, and the bird will be ready for packing directly it is quite cold.

Ducks and geese have the wings turned, and are usually weighted, to compress them into a good shape. This should be done when they are warm, otherwise they do not set properly.

Turkeys are either tied down in the way described as the Devonshire fashion for fowls or in the Norfolk fashion.

Grading and Packing.

It is important that all poultry should be quite cold before being despatched. On large plants a chilling chamber is found most useful, but failing this the birds should be allowed to remain for some hours in a cool room, until the body heat is entirely gone.

The question of the grading of poultry is also of great importance. It is very desirable that only birds of about the same size should be packed together, but if those of different sizes must be placed in the same package they should be arranged in layers, and the fact that they are so packed should be stated when advising buyer of despatch. The sizes may be 3 to 3½ lb., 3½ to 4 lb., 4 to 4½ lb., and 4½ to 5 lb. It is advisable that the crates, baskets or boxes used for different sizes, should be marked with a distinctive brand and clearly show the number and size of the birds. In Surrey it is the practice after the chickens have been shaped for them to be floured and packed in specially made crates called "pads," which are of different sizes and hold respectively twelve, sixteen, twenty, and twenty-four birds.

Ducks, geese and turkeys should be sent in baskets or strong crates, with the number and actual weight of the contents marked on the outside at one end.

In packing poultry the birds should be laid breast downwards on clean straw, and packed as tightly as possible to prevent them shifting while on rail. The best packers place clean butter paper between each layer of birds to prevent the straw marking the backs and rubbing off the skin. Though this means a few more minutes per package, it brings a more ready sale.

Forwarding.

A postcard should be sent to the buyer or salesman advising him by what route and train the crate will travel, whether it is to be despatched carriage paid or carriage forward, and by what mark he will be able to identify it.

The crate should travel by an evening train in order to reach the market in the very early morning, and it should be consigned at dealers' rates. In warm weather the birds are less likely to be heated if they travel by night.

General.

There is a growing demand for goslings weighing from 6 to 8 lb. during the London season—from the middle of May to the end of June. Goslings sold then are off the ground before keep becomes valuable for other farm stock.

Fowls should not be drawn when sent to the markets, but during the hot months some buyers prefer them to be "roped," that is, to have the intestine drawn out at the vent, leaving the rest of the inside intact. This practice is frequently adopted in the Midlands and Ireland, but except in hot weather it is not generally necessary, as, unless the distance from the market is considerable, the birds are unpacked and sold within a few hours of despatch.

The practice of keeping old hens long after they are really profitable from a breeding or laying point of view is to be deprecated. Hens are rarely worth their keep after the conclusion of their second year and it is then generally better to sell them. There is a good demand for live fat hens at Easter, and again in June and July.

Whitehall Place, London, S.W.,

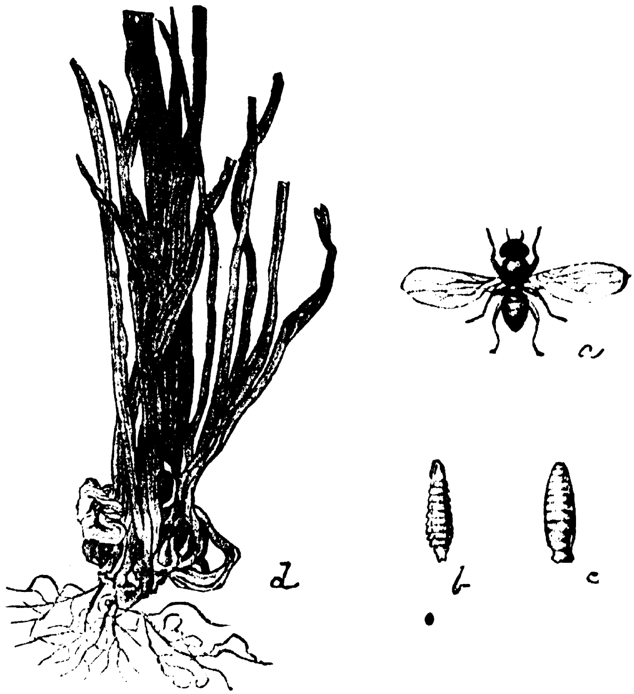
July, 1908.

Revised, October, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Frit Fly (*Oscinis frit*).



a. The Frit Fly, *Oscinis frit*; *b*. Larva; *c*. Puparium; *d*. Young infested plant; (*a*, *b* and *c* much enlarged).

The larvæ of the *Oscinids* or *Chloropidæ*—a group of tiny two-winged flies—are known to be very injurious to cereals and pasture grasses in Europe and America. The species *Oscinis frit* is one of the chief cereal pests in Europe, and there are Continental records of *Oscinid* attacks on oats, barley, wheat, rye, maize, and various grasses. In Britain the chief crop attacked is oats, although barley may also suffer. The larvæ or maggots of the fly do the harm by feeding in the heart of the young plants or in the grain in the young ears, according to the time of the year and the different broods of the insect.

Evidence has been obtained both in this country and abroad which shows that different varieties of oats vary greatly in their powers of resistance to the attacks of the insect. It is not possible yet, however, to make any definite statement on this point.

Symptoms and Result of Infestation.—(1) Pale spots may show on the upper parts of leaves still green, the result of the gnawing of the tissue by the larva before it proceeds downwards and inwards; (2) a browning or reddening of the leaves; and (3) a stunted growth and failure of the plants. The plant may not be hopelessly destroyed, as there may be a tendency to tiller; the new shoots, however, are often twisted and swollen, and simulate the appearance of eelworm infestation (Fig. *d.*). This is occasionally quite a marked feature of frit-fly infestation. Eelworm attack very often accompanies attack of the frit-fly maggots.

Where the grains are attacked they are hollow, shrunken and shrivelled.

Description.

Fly.—The adult fly (Fig. *a.*) measures less than $\frac{1}{8}$ in. in length. The body is bright shining black, and the legs are also black, except the feet, which are yellow or brown-yellow. The wings are delicate and transparent, with the fore-edge brown. In the fields, the fly has a characteristic skipping movement.

Larva.—The maggot (Fig. *b.*) measures $\frac{1}{8}$ in. in length and is round, fleshy, and legless. At the front end are two curved mouth-hooks, and at the blunter hind end there may be seen, on examination with a lens, two projecting spiracles. Under a good magnification branched respiratory processes will be found at each side of the head.

Puparium.—The maggot pupates under cover of its last moulted skin, the resulting puparium or pupa-case (Fig. *c.*) being red-brown and round, with well marked (spiracular) processes at the hind end.

Life History.

Typically, three generations are possible in the year. The flies of the first generation issue in April and the beginning of May, and proceed to lay their eggs on the young oat plants. The eggs are laid on the leaves, and several eggs are deposited on each young plant. The maggots on hatching pass to the lower part of the plant, behind the leaf sheaths

and right into the heart of the plant. The full grown maggots pupate in the plant, and by the month of July the next generation or brood of flies begins to issue. If, from any cause whatever, the oats still produce new young shoots the flies may lay on these, but the flies of the July brood are generally supposed to lay their eggs on wild grasses, and, if the stage of the plant is suitable, in the ears of oats (and barley) where the grains are young. The maggots of this brood are therefore harmful both to vegetative parts and to grain. Infestation in the ears may not show itself externally, the grains being under cover of the glumes, but the result appears at harvest in the shape of light samples and of gnawed, shrivelled grains. This attack on the ears is more characteristic and severe in northern countries than in the south, as the age and condition of the ear render it more suitable for the egg-laying of the brood that has developed in young oat plants.

In August and September the third brood of flies emerges, and may on occasion be found in swarms in places where grain threshed from infected ears has been stored.

It has been shown experimentally that these flies lay their eggs on grasses (*Avena elatior*, Arrhenatherum, sp.), but exactly which grasses are attacked in the open is not yet known. The maggots produced by this brood feed and pupate in due course and the flies issue from the pupæ in April and May.

Prevention and Remedy.

1. The foregoing life history will have made clear the importance of a correct sowing period. The oats should be put in as early as possible so that the plants may make some progress before the issue of the April and May brood of flies. The flies choose for their egg-laying young tender parts, and grown plants are therefore made use of less willingly, and even if they are infested, they suffer less.

The wisdom of early sowing in dealing with the Frit Fly has received repeated confirmation. Miss Ormerod quotes two cases :—"All early spring fields seem to have escaped, while in some others, sown late, 90 per cent. of the crop is gone." Again, "One field of oats sown on 29th March enjoyed almost complete immunity ; in another field sown on 29th April over 70 per cent. of the first stems were destroyed."

One of the correspondents of the Board writes, "Oats sown in March are not attacked; those sown in April on land in first rate order came up well, but a great quantity are attacked." Early spring sowing, however, is not an unfailing protection. Winter sowing should be tried.

2. Where attack is feared, or noticed early, a stimulating dressing should be applied.

3. Badly infested plants cannot be saved, and should be ploughed in deeply.

4. If a crop was known to be infested in the autumn or winter, the planting of oats near such an area in the next season should, as far as possible, be avoided.

Whitehall Place, London, S.W.,

December, 1907.

Revised, July, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 203.

BOARD OF AGRICULTURE AND FISHERIES

The Utilization of Peat Lands.

Considerable areas of peat land exist in Great Britain, and although there are many obstacles to their remunerative employment, it may be useful to direct attention to the measures which have been successfully adopted on the Continent.

Societies for the purpose of encouraging the development of peat lands, both agriculturally and industrially, exist in Germany, Sweden, Denmark, Holland and Austria, while there are a number of State experimental stations and moor farms devoted to the same object. These serve as centres for the the dissemination of information and advice on the subject, and, besides providing a demonstration of different methods, conduct actual trials on a practical basis and carry out scientific research. It is to the information thus made available that the progress in the utilization of peat lands abroad must be largely attributed.

The problem of the best method of turning these waste lands to some profitable use may be approached from two sides, either as regards the industrial use of peat for fuel, for fibre, fodder, litter, &c., or agriculturally with a view to the reclamation and cultivation of the soil.

Industrial Products from Peat.

As regards the industrial products fuel is perhaps the most important, and there are three kinds of peat fuel commonly employed in Europe :—(1) The "cut peat" prepared by cutting the crude peat out of the bogs into blocks and drying in the air ; (2) "machine peat," procured by pulping the wet material, sometimes with the addition of water, and then cutting or moulding into blocks and drying with or without artificial heat ; and (3) "peat briquettes," made by artificially drying and compressing powdered peat. Peat charcoal is also made.

Another way in which peat is used industrially is in the manufacture of peat moss litter, peat dust, and peat fibre. Peat moss litter (Torfstreu) is very valuable as a substitute for straw, as it is very absorbent and prevents the escape of nitrogen in the form of ammonia. The material used for these products is the layer lying between the living vegetation which usually covers the surface of peat moors and the true black turf which is used as fuel.

The process of manufacturing moss litter is a comparatively simple one. The peat is first cut by hand and dried in large stacks in the open air. When dry it is removed to a factory

where it is torn into fragments by machinery and passed over sieves to remove the dust. The litter is then pressed into bales. The peat dust (Torfmull) is used for disinfecting purposes, for preserving meat, fish, and fruit, and for the filling-up of walls and ceilings, &c. Fibre and very many other substances are also manufactured to a greater or less extent from peat, and among them may be mentioned fabrics, paper, pasteboard, tiles, paraffin, alcohol, creosote, and sulphate of ammonia.

Reclamation of Peat Lands.

As regards the reclamation of peat lands for agricultural purposes, Continental experiments tend to show that with the aid of artificial manures it is possible to utilize this type of land for growing a variety of crops.

Dranage.—Moorland in general may be regarded as land which, besides being poor in nutritive elements, is handicapped by unfavourable physical conditions. The first step in its reclamation is to change the physical conditions in such a way that cultivated plants may be able to exist. This can only be effected by drainage, which admits air and allows of the decomposition of the peat. The matted structure of the turf breaks down, and after cultivation the peat turns finally into a black crumbly mass. Moreover, after draining, the peat contracts and the moor settles, frequently to a very noticeable degree. Several methods of removing the superfluous water can be adopted, such as deep open ditches, pipe drains, and various kinds of bush drains. Drain pipes are very liable to be displaced in consequence of the softness of the ground, but in experiments at the Bernau Experiment Station (Bavaria) the following plan has been found satisfactory, subject to modifications to suit local conditions. Ditches are dug about 2 ft. wide, rather over 2½ ft. deep, and about 65 ft. apart, on some suitable system which will vary somewhat according to the lie of the land. The vegetation is then thoroughly destroyed by hoeing, roots and stumps are removed, and the whole surface is levelled and if possible harrowed two or three times. In the following spring the ditches, which will have settled during the winter, are deepened to about 4 ft., earthern drain pipes are carefully laid and the ditches then filled in. If the nature of the subsoil makes it necessary, the pipes may be supported by wooden laths placed underneath to keep them in position.

Two less expensive methods are recommended by Dr. Bersch,* the Director of the Admont Station (Austria), as being very suitable where the pipes are liable to displacement. In places where rough boards and waste wood from saw-mills

* "Die Praxis der Moorkultur." *Zeitschrift für Moorkultur und Torfverwertung.* Vol. IV., No. 3, 1906.

can be obtained cheaply, the drainage can be effected by placing boards at the bottom of a ditch with supports between, so as to leave open spaces for drainage. A somewhat similar method consists in the use of thin poles from the undergrowth of alder, mountain pine, birch, &c., a material which exists in abundance on most Alpine moorlands, and has hardly any value as timber. A ditch is dug about 2½ ft. wide at the top, 1 ft. wide at the bottom, and about 4½ ft. deep. Two stout sticks about 2½ ft. long, with one end of each resting on the bottom, the other on the opposite side of the ditch, are then placed crosswise over a strong rail, which is laid on the bottom of the trench and which prevents them sinking in the soft ground. These cross sticks are placed at distances about 3 ft. apart and leave a considerable opening for drainage. They serve as supports for three or four stout alder or pine poles, which are laid on them and bear the weight of the earth when the ditch is filled in, thus preventing the "drain" from sinking. The space between the poles is filled in with loppings from boughs, &c., and the whole covered in, so that the upper layer of soil is again placed on the top. A wooden pipe hollowed out of a stout pole may also be inserted to secure free drainage. This method, according to Dr. Bersch, is preferable to any other system where the material is available, because so little risk is involved. It is so simple that it can be carried out by any intelligent workman without technical help, a stoppage of the drains practically never occurs, and the aeration of the soil is quite satisfactory. The fall should not be less than 3 per 1000.

Drainage is much to be preferred to open ditches, as, apart from the loss of land, drained soil dries and is accessible very much earlier in spring. Land drained by open ditches becomes frozen not only from above, but also from the sides of the ditches, and drainage can only take place after the ice has melted. Drains, on the other hand, continue to act in winter, especially when the land is deeply covered in snow. This has been frequently proved at Admont, where it was found that a pipe or bush-drained area of 5 acres could be cultivated nearly three weeks earlier than adjoining land drained by open ditches. The distance apart of the drains is of the greatest importance and must receive careful consideration in connection with the rainfall and its distribution over the year, as although insufficiently drained land can be improved by laying further pipes, over-drained land can only with great difficulty be put right. The purpose for which the land is to be used must also be considered, as the water level must be reduced more for tillage than for grass.

Ploughing and Tillage.—When the drainage has been carried out, the land must be grubbed, ploughed, and harrowed. Any strongly built plough may be used, the

horses being shod with broad wooden shoes, to which they soon accustom themselves. Disc harrows and strong cultivators are also useful, but if horse implements cannot be used the work must be done by hand.

Sanding and Liming.—Reference may also be made to the method of reclamation practised at the Swedish Experiment Station at Jönköping.* Here the drainage is done by open drains $1\frac{1}{2}$ ft. deep, about 40 ft. apart, which are led into a large main drain. The heather is then cut and removed and some levelling done. Sand is next carted or brought by light tramway and spread 2 or 3 ins deep over the levelled ground. About 30 barrels of lime per acre are also applied. As soon as possible this is worked into the soil by means of cultivators or disc harrows, and it is allowed to rest for a season. The ground is then manured in accordance with the results obtained from the experimental plots, and afterwards cropped.

The system of sanding the surface of bog-land is much practised in Germany, where it was first introduced by Rimpau on the Cunrau Moor. Here the subsoil consists of sand, which is thus available at a very low cost, and it is only where this is the case that the method can be adopted with economic success. Generally speaking, however, experience on the Continent shows that the reclamation of moorland, when properly carried out, proves a very satisfactory undertaking both from a financial and an economic point of view.

Manuring.—The general term "moorland" covers a very great variety of soils, and the method of cultivation and treatment must be varied to suit each individual case.

The richness in nitrogen of low marshy moorland makes any addition of nitrogenous manures generally unnecessary, and it is the natural stores of nitrogen which make the cultivation of this type of land so advantageous. Upland moor, on the other hand, is apt to be very poor in nitrogen. The content of both in phosphoric acid and potash is small, but lime is generally unnecessary, although it is useful in some cases to sweeten the soil and hasten decomposition. Experiments in Germany have shown that its place, in the earlier years, can well be taken by basic slag.

In soils poor in nitrogen, farmyard manure supplemented by nitrate of soda or sulphate of ammonia is recommended; the dung brings with it bacteria, which, as these soils are generally very poor in micro-organisms, are of value. As regards phosphoric acid, basic slag is found to be the most useful manure, but superphosphate may also be used. Potash may be supplied in the form of kainit. The land

* Journal of the Department of Agriculture and Technical Instruction for Ireland, Vol. IV., p. 463, March, 1906.

requires manuring annually, and the following figures are given by Dr. Bersch as indicating the limits of the quantities necessary :—

——	Lowland Moor.		Upland Moor.		
	1st Year.	2nd Year.	1st Year.	2nd Year.	3rd Year.
	Pounds per acre.				
Phosphoric acid	90-135	55-90	180-270	90-180	45-55
Potash	110-180	70-110	180-270	90-180	90-180
Nitrogen ...	...	...	45-68	27-45	27-45

Crops.

Moorland naturally requires somewhat heavy dressings of manures, which should be given in the spring, as the heavy winter rains would wash them away if applied in autumn. On the upland moors the first crop selected, both in Bavaria and Austria, is potatoes, which gives a high yield and leaves the field clean, while the hoeing which the crop receives much contributes to a good tilth.* In the first year the manure applied per acre represents 180 lb. to 270 lb. phosphoric acid, the same amount of potash, and 68 to 90 lb. nitrogen.† The superphosphate and potash are spread broadcast before planting, and the nitrate of soda is given about three weeks after. In the second year about 110 lb. of phosphoric acid and the same quantity of potash are applied, with about 40 lb. of nitrogen as a top-dressing. Potatoes are not planted after the second year, as the yield diminishes very much. The maximum yield obtained reaches 10 to 15 tons per acre.

The crop selected in Bavaria in the third year is, normally, winter rye, which receives about 110 lb. of potash, half that quantity of phosphoric acid, and 40 lb. of nitrogen.

In the fourth year, oats are grown or the land is laid down to grass. In either case it is usually desirable to apply lime, but only a small quantity, about 5 cwt. per acre, appears to be used. If oats are grown the manure applied is similar to that for rye, but with rather less nitrogen. Before laying the land down to grass, other fodder crops can be grown, such as peas and vetches, but deep rooting plants, such as turnips, kohl-rabi, or carrots are not reliable. Many garden vegetables are found to do well if heavily manured, and also strawberries.

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* See "Bayerns Moore und ihre Kultur." *Fühling's Landwirtschaftliche Zeitung*, June 15, 1906.

† To supply 100 lb. phosphoric acid, applications of 5-6 cwt. basic slag or 7-8 cwt. superphosphate of lime would be necessary, while it would take 7 cwt. kainit to supply 100 lb. of potash and nearly 6 cwt. nitrate of soda to supply 100 lb. nitrogen.

Although the cultivation of field and garden crops is found to be thoroughly satisfactory, experience on the upland moors of Bavaria is not favourable to the laying down of permanent pasture. Grass is found to grow very well for the first two or three years, after which it deteriorates and the land has to be ploughed up. The crop from rotation grasses and clovers is, however, said to be very good if suitably manured.

Low-lying moor or fen land presents different conditions, and in some cases a great improvement can be effected in the natural flora, without previous cultivation, by manuring with basic slag and kainit. It is usually better, however, to break up the soil, take one or two crops, and then sow grass and clover about the third year.

Some other crops, such as maize, vines, and hops, have also in individual instances been cultivated on moorland. With regard to the latter crop, its cultivation seems to have met with considerable success in Austria in the neighbourhood of Salzburg,* where it has been grown since 1900 and where some 125 acres are now planted with hops. *The plantations made in 1901 yielded 8 cwts. per acre in 1903, 13 cwts. in 1904, and 13½ cwts. in 1905, while those planted in 1903 yielded about 6½ cwts. in 1904 and 1905. These figures are stated to compare favourably with the yields obtained in hop-growing districts in Bohemia, and the quality is also quite satisfactory. The success which has attended the cultivation of hops here, if not necessarily applicable to moorland elsewhere, affords an example of the capabilities of such soils when properly cultivated and suitably situated.*

The crops most cultivated at the Swedish Experiment Station at Jönköping are peas, beans, rye, oats, mangolds, potatoes, rye grass and clovers. It is not considered advisable to leave the land in grass more than five or six years.

Whitehall Place, London, S.W.
February, 1908.

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* *Zeitschrift für Moorkultur und Torfverwertung.* Vol. IV., No. 1. 1906.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 204.

BOARD OF AGRICULTURE AND FISHERIES.

Apple Tree Mildew (*Podosphaera leucotricha*, Salm.).

The disease known as Apple Tree Mildew is a close ally of the hop mildew, American gooseberry mildew, and rose mildew. It is very prevalent.

The winter or ascigerous form of fruit is not common, and was first recorded in this country from an orchard at Mortlake. Since then it has been noted in other districts by various observers. This form of fruit is however, certainly too local in its occurrence to account for the universal distribution of the mildew in the spring, which must, therefore, originate either from the conidia or summer form of fruit, which would imply the power on their part of germinating the year following their production, or from hibernating mycelium. For the former of these two alternatives there is no precedent among mildews.

Damage done by the Mildew.

As a rule the fungus completely checks the growth of the branches, and, consequently, all the leaves that under normal conditions would have been scattered at intervals on a long shoot, are crowded into a rosette at the end of a branch of the previous season. Such leaves are stunted in growth, and covered with a dense white powder, consisting of the summer form of fruit of the fungus. The mildew has recently been recorded as spreading on to the fruit.

The disease is much more prevalent on old or full-grown trees than on nursery stock, and when present on the latter rarely arrests the growth of the branches.

Preventive and Remedial Measures.

1. When the disease is present in its worst form, the only certain method of arresting its progress is to cut off and burn all the infected rosettes of leaves. The cut should be made about 2 in. behind the tuft of leaves. Trees that have been treated in this manner throw out healthy branches and remain free from the disease.

2. When the disease appears in a mild form on the scattered leaves, the tree should be sprayed with a solution of liver of sulphur, 1 oz. dissolved in two gallons of water.

Infection of the leaves only takes place when they are quite young, and then is the time to look for the mildew. On the first symptoms of its appearance spraying should be commenced. If this opportunity be neglected and the mildew is allowed a start, spraying may be considered useless.

3. It would under all circumstances be advisable to spray trees where the disease had previously existed, commencing when the leaf-buds are expanding.

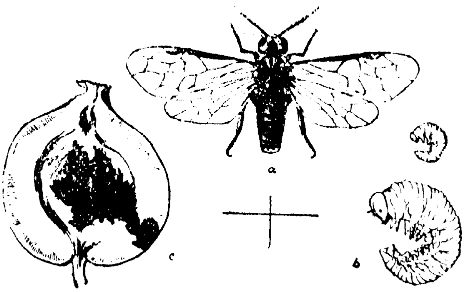
4. No definite proof is as yet forthcoming as to whether insects assist in distributing the spores of the fungus, or aiding in its attack in any other way. It is, however, quite certain that mildew is most abundant on trees that are infested with "woolly aphis" and "green fly," consequently these pests should be dealt with. (*See* Leaflets 34 and 104.)

NOTE.—In previous issues of this Leaflet the mildew was termed *Sphærotheca mali*, Mag.

Whitehall Place, London, S.W.,
January, 1908.
Revised, December, 1909.

BOARD OF AGRICULTURE AND FISHERIES.

The Apple Sawfly (*Hoplocampa* (*Tenthredo*) *testudinea*).



a.—MALE SAWFLY (lines showing nat. size): *b*.—CATERPILLAR (nat. size and mag.); *c*.—INJURED APPLE (nat. size).

The Apple Sawfly, though a serious pest in many parts of the country, frequently passes unrecognised since the injury it causes resembles in many ways that of the better known Codling Moth (*Cydia pomonella*.) (*See* Leaflet 30.) It is necessary, however, to distinguish between the two insects since some of the measures of service in the control of the Codling Moth are useless in the case of an attack by the Apple Sawfly. The essential differences are given under the headings "Description," and "Nature of Damage."

The Apple Sawfly is widely distributed in England and it has been reported as injurious in parts of Scotland and Ireland. In Continental Europe it has been recorded from Sweden, Germany, Holland and France.

Description.

Adult Sawfly.—The general shape and appearance of the adult may be seen from Fig. *a*. In colour it is reddish yellow, with the top of the head, the thorax between the wings and the upper side of the abdomen, black. It measures about $\frac{1}{4}$ inch in length and about $\frac{5}{8}$ inch in spread of wings.

Larva.—The form of the larva is shown in Fig. *b*. In colour it is usually white or cream, but, according to Theobald, pink specimens sometimes occur. When first hatched the head is black and there is also a black plate over the anal (or "tail") segment, but later the head becomes

light brown and the tail plate greyish. There are ten pairs of legs and this character may be used to distinguish the Sawfly larva from that of the Codling Moth. In Sawfly larvae it will be found that there are three pairs of true legs directly behind the head, which are followed by seven pairs of "sucker" legs including the clasper-like pair at the tail. The Codling Moth larva also possesses the three pairs of true legs but there are only five pairs of sucker legs. The general appearance also of the Sawfly larva differs from that of the Codling Moth and when the two larvae have once been definitely identified by the character given above they will afterwards be known at a glance.

Cocoon.—The larva pupates in the ground in a yellowish silken cocoon to which grains of earth are attached.

Life History.

The adult Sawflies leave the cocoons at the end of April and in May, appearing during the period in which the apple is in flower. They may then be found on bright days sitting on the blossoms. The eggs are laid on the flower below the calyx, one egg only being placed on each blossom. After a period varying from a week to a fortnight the egg hatches and the young larva burrows into the developing fruitlet and eats out a large cavity in the interior. This cavity communicates with the exterior by means of a small hole through which wet frass exudes, thus indicating the attacked fruitlets. The larva may require more than one fruit for its support and it may, therefore, leave the original fruit on which the egg was laid and crawl away to attack others. After from four to six weeks the larva is full fed and it then leaves the tree and spins a cocoon in the soil at a depth varying from 1–4 inches. The attacked fruits seldom grow to any size, and the majority usually falls off in July. Some of the larvae remain in the fruit until it falls but most have become full fed and have left before then. The pupae normally remain until the following spring before the adults emerge, though occasionally there is said to be a small second brood in July.

Nature of Damage.

The actual loss in fruit is too obvious to need further remark, but a note may be given as to the distinguishing features between the injuries caused by Sawfly and those due to Codling Moth. The Sawfly larva enters through the side of the apple and eats out a large irregular cavity. The Codling Moth larva enters through the "eye" and tunnels down through the core, feeding mainly on that portion of the apple; it then mines a hole to the exterior through the

side of the fruit. The large irregular cavity is, therefore, characteristic of the Sawfly, while the tunnel down the core is usually the work of the Codling Moth. A further form of injury attributed to the Sawfly consists in curious ribbon-like scars sometimes found on the skin of the apple. These scars are said to be made by the Sawfly larvae in their efforts to bite a way in through the skin of the apple.

Methods of Control.

No practical measures for the control of this insect have yet been discovered. Spraying with lead arsenate or Paris green have been tried without success, the failure being probably due to the fact that the larva enters through the side of the fruitlet and not through the "eye." In the case of the Codling Moth sufficient poison is retained in the eye to poison the young larva. Deterrent sprays against the adult Sawfly have not proved of much use. The measures which have been found of service are as follows, but they are suited to small gardens rather than to fruit-growing on a commercial scale:—

(1.) All attacked fruits should be picked off the tree and destroyed before the larvae have left them.

(2.) The pupae in the soil may be destroyed by carbon bisulphide injections or by the use of some other powerful soil fumigant.

(3.) By thoroughly working the soil under attacked trees some of the pupae may be exposed to the attacks of birds while others may be injured in the process or prevented from emerging. A dressing of kainit is said to be beneficial.

Whitehall Place, London, S.W.,
August, 1908.
Re-written, October, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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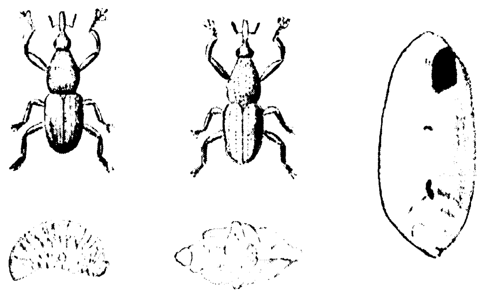
Leaflet No. 206.

BOARD OF AGRICULTURE AND FISHERIES.

Grain Weevils.



WEEVILS OF *C. granaria* (ON THE LEFT) AND *C. oryzæ* (ON THE RIGHT), WITH GRUB, PUPA, AND DAMAGED GRAIN (FROM LEFT TO RIGHT BELOW). ALL MUCH MAGNIFIED.

Harm Done.

Grain weevils (*Calandra granaria* and *Calandra oryzæ*) are extremely destructive to stored grain and to cargoes of grain in ships. Cargoes of grain and rice carried long distances sometimes arrive swarming with the pests. The weevils, too, are often very troublesome in breweries and malting sheds. Wheat, barley, oats, and Indian corn may be infested, and *C. oryzæ*, as its specific name implies, is very harmful to rice.

The harm is done both by the adult weevils and their grubs. The weevils feed on the grain, eating into it and so hollowing it out that a mere husk may be left. After the contents of the grain have been partly eaten away, it is common to find several weevils at work inside the damaged grain. The grub is hatched inside the grain and spends its whole life there, so that by the time it is full grown the grain is ruined. The species of the genus *Calandra* are really natives of warmer countries than Britain, but some of the species have been spread in commerce, and *C. granaria* at least may now be considered a native of European countries.

Description.

The Weevils.—Characteristics of these weevils are the long snout with elbowed antennæ, and the narrowed body with its long thorax.

C. granaria measures $\frac{1}{8}$ in. in length. In colour the beetle is brownish-black or pitchy; the elbowed antennæ and the six legs are reddish. The snout or rostrum is long, but rather shorter and stouter in the male than in the female.

The mouth is placed at the end of it. If examined with a lens the thorax is seen to be covered with punctures; the wing-covers are striated and also show punctures. *C. oryzæ* is very similar to *C. granaria*, but the two may be distinguished as follows:—

Calandra granaria.	*Calandra oryzæ.*
All one colour, and with a more shiny surface. Punctures on thorax larger, not so close together, and oblong. No functional flying wings.	The wing-covers have two orange-coloured patches at the apex and at the base. Punctures on thorax smaller, closer, and rounder. Well marked flying wings.

Larva.—The grubs are white, with yellow-brown horny heads and biting jaws; the body is wrinkled and without legs.

Life History and Habits.

The females lay one egg in each grain. The grub on hatching feeds on the contents of the grain and when full fed pupates in the eaten-out grain. In conditions extremely favourable to the weevils the whole life-cycle can be completed in a month, but at lower temperatures and under ordinary conditions a considerably longer time is taken. It has been shown* that a temperature of 80° Fahr. is the most favourable for the development of the beetles. *C. granaria* can withstand lower temperatures than *C. oryzæ*, while the latter can, on the other hand, endure higher temperatures than *C. granaria*. Moisture in the form of water-vapour is very favourable for the weevils. A close and confined atmosphere is also likely to favour the growth of these pests.

The weevils live for a long time. Kept in small corked tubes containing grain, in a sitting-room that had a fire in winter, some of these beetles (*C. granaria*) lived for nearly 14 months; there was no hibernation in the winter, and 7½ months passed before the first beetle died. Eggs were laid in every month of the year. Four tubes from which the weevils that had laid eggs in the grain had been removed, were kept securely corked for 9 months. The tubes showed at the end of this time frass and moisture and mouldy grains. Each tube held a large number of weevils that had developed from the egg stage in the enclosed grain.†

On being touched or shaken the weevils feign death; they lie, often for a considerable time, refusing to show any signs of life, even when handled. MacDougall found that movement could be induced by breathing on them.

* "The Bionomics of Grain Weevils."—F. J. Cole, *Journal of Biology*, 1906, Vol. I, Part 2.

† MacDougall, *Journal of the Board of Agriculture*, Vol. XIV., No. 7. Oct. 1907, p. 412,

Remedial Measures.

1.—Fumigation with bisulphide of carbon is a very satisfactory way of ridding grain of the insects. The grain to be treated should be put in a bin or air-tight receptacle, and the bisulphide of carbon poured into a saucer or shallow vessel and laid on the top of the grain. The liquid quickly volatilises, and the fumes, being heavier than air, sink down through the grain and kill all insect life ; 1 lb. of bisulphide of carbon is sufficient for 100 bushels of grain. The air-tight receptacle should be kept closed for 24 to 48 hours. A shorter time would do for small quantities of grain. In treating a store or mill, 1 lb. of bisulphide of carbon is sufficient for every 1,000 cubic feet of space. Before entering the mill after such fumigation the doors and windows must be thrown open for an hour or two in order that the place may be well ventilated. If necessary a second fumigation might follow the first.

Bisulphide of carbon has a very disagreeable odour, and as the fumes are poisonous they should not be breathed, though a little will do no harm. It is also explosive, and must be handled with care. No naked light should be brought near it, nor should the operator smoke.

2.—Infested grain may be run through a sieve or a screen, the meshwork of which is sufficiently fine to keep the grains back and yet let the weevils fall through, these being caught in a receptacle placed underneath containing paraffin. This sieving or screening, however, fails to reach grains that contain eggs or developing larvæ. The same objection can be urged against the practice of screening under a strong air blast, for infested grains will still, to some extent, remain behind.

3.—For cargoes in ships, thorough ventilation should be practised, this keeping down the temperature and ensuring dryness of the grain.

Whitehall Place, London, S.W.,
July, 1908.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 207.

BOARD OF AGRICULTURE AND FISHERIES.

Strawberry Cultivation.

Strawberry growing has for some time been an important industry in certain localities. The area in England and Wales returned as under strawberries alone, or with only a very small admixture of other fruits, on holdings exceeding one acre was 20,968 acres in 1912, the leading counties being Kent, Cambridge, Hampshire, Norfolk and Worcester.

The industry is a very suitable one for small holders, although considerable initial capital is required. It has been found in Hampshire, where strawberry growing is extensively carried on, that a man can often make a moderate living from two acres of land under strawberries, while in many instances a family may be said to be comfortably provided for on a holding of four acres.

Gross returns may be said to lie between £40 and £60 per acre, but may fall as low as £20, while in a favourable season they may rise to as much as £100. Strawberry growing, however, is attended by considerable risks, and the beginner will often find that late frosts towards the end of April or in early May may spell disaster to his crop, and involve the loss of a considerable portion of his capital.

Soil.

Good heavy land, especially if such land has a warm aspect, makes an almost ideal strawberry soil. Heavy land holds moisture well, and does not require so much manuring as land that quickly 'dries out.' Soil just too heavy for potatoes also makes good strawberry land. Different varieties of strawberries, however, require somewhat different soils; for example, a heavy soil is more suitable for the Paxton than for either Royal Sovereign or the Laxton, as both these varieties produce an excessive amount of foliage in the second and third seasons when grown in a retentive loamy soil, especially if manure has been liberally employed. On the whole heavy soils are preferable to light soils, even stiff clayey loams giving excellent results in many districts.

Where other conditions are favourable, but the land at first sight seems unsuitable, it would be desirable to test its strawberry-growing capacity by planting a small area as an experiment, for experience has shown that land not possessing any apparent qualifications may in some cases by suitable cultivation be made to yield heavy crops. Many of the strawberry plantations of Hampshire are examples of this, as they have been formed on heath land which was considered unsuitable for ordinary farming.

In forming a new plantation the ground should be thoroughly cultivated to a depth of 12 or 15 inches by ploughing and sub-soiling, or by double digging.

Any acidity in the soil should be counteracted by the application of ground lime, which should be raked or harrowed in before planting. The quantity applied will vary according to the state of the ground, but will as a rule be from 10 to 12 cwts. Ground lime can usually be bought at 1*s.* per cwt. where more than a ton is obtained. It should be guaranteed to contain at least 70 to 75 °/$_0$ quick lime.

Manuring.

Owing to the extent to which strawberries exhaust the land, and to the risk of damaging the bed by subsequent manuring, the soil must be well manured at the outset. As much as 20 to 30 tons of good short dung may be applied per acre when the bed is formed, and 10 tons in the autumn after the second crop is taken. Bone manure may be substituted for the latter dressing, but artificial manures are not in general use. The best general treatment is probably a light annual dressing of dung, with from 4 to 6 cwt. of superphosphate and 2 cwt. of nitrate of soda per acre.

The cost of farmyard or town manure may be put at about 6*s.* 6*d.* per ton, and in addition 2*s.* per ton for haulage to the ground, and from 2*s.* to 3*s.* per acre for spreading, must be allowed, so that the average cost of manuring will work out to something like £9 to £12 per acre.

Planting.

Strawberries may be planted either in the autumn or the spring. If planted in a good soil in September or October a small crop of quite good fruit may be gathered the following year. The importance of this lies in the fact that a small return is obtained a year earlier than if the planting were done in the spring. Many growers, however, consider that September is too early for planting owing to the runners not usually being sufficiently established, and also regard it as undesirable to take a crop the first year. October is probably the most usual time for planting, or else February or March. In planting it is important that the crowns be kept well below the surface of the ground, without being buried. If the crowns are above the surface the new roots which are continually forming near the surface will suffer for lack of moisture. The plants will throw out runners in May or June. These may be allowed to remain if the plants are strong ones, but if the plants are weak and backward, some growers consider that the runners should be removed at once, each plant being allowed to concentrate its energies on the development of the first truss of flowers. On the other hand, backward plants may thrive later in the season and it is doubtful if the advantages gained by removing runners will pay for the extra labour involved.

The cost of runners varies according to variety and quality, specially layered plants costing from 10*s.* to 15*s.* per 1,000,

while "runabouts" (ordinary runners) may be bought from growers in Hampshire for about half these amounts. Assuming that less waste is entailed in the purchase of stocky runners, and that weaklings are often planted in pairs, the average cost of plants per acre is from £4 to £8, 12,500 to 16,000 plants being required for each acre of ground. If planted 2 feet apart each way, nearly 11,000 plants are required per acre, but the distances between the rows and between the plants in the rows may vary considerably; for instance, rows 30 inches apart, and 12 to 15 inches from plant to plant, are common, while, on the other hand, "Paxtons" and "Nobles" are planted 2 feet from row to row, and 1 foot from plant to plant, in which case nearly 22,000 plants per acre are required.

Varieties.—Particulars of some useful varieties of strawberries are given below :—

Bedford Champion.—A large, handsome, richly coloured mid-season fruit. In much favour with growers, as the flesh is firm, and the fruit bears packing and travelling well.

Givon's Late Prolific.—A valuable dark crimson skinned variety for the last crop. A vigorous and free cropper.

Royal Sovereign.—A large and early variety, of good flavour; excellent for market and forcing.

Sir Joseph Paxton.—A large and prolific mid-season variety, having a good flavour and standing packing well.

Noble.—A large early variety, selling well until others are ready, but soft and bearing packing badly.

The Laxton.—A large, handsome, oval fruit, having a good flavour, but not packing so well as some varieties.

After Cultivation.

Pending the arrival of harvest time, a good deal of labour is involved. Where land is infested with weed seeds, and therefore liable to become foul very quickly, three hoeings are often necessary before the crop comes into profitable bearing, and each hoeing may cost as much as £3 per acre, so that the cost of cultivation, including the removal of runners, from the time of planting to the period when the fruit is fit for gathering—on an average about twenty months—will amount approximately to from £9 to £12 per acre. In some cases the charge for this work may be £15 or even £20 per acre. On a small holding, most of this work would be done by the occupier.

Another item of expense is the cost of bedding with straw for the fruit to rest upon. There is no objection to bedding with manure, made with straw, provided it be placed on the ground in early spring. The practice of applying manure immediately before blossoming is however to be condemned unless fresh straw is applied afterwards. Most growers now use clean barley or oat straw at the rate of from 15 cwt. to 1 ton

per acre, the cost of the straw being from 35*s.* to 40*s.* per ton, with the additional expense of 8*s.* to 10*s.* per acre for laying or bedding it between the plants. A large quantity of medium quality straw is now steam baled and sold for bedding strawberries.

A further annual charge is the cost entailed in cleaning the plantations of weeds, clearing up straw, and trimming plants after the fruiting season is over. The cost of these operations may be put at from 10*s.* to 15*s.* per acre.

Life of the Beds.—A strawberry plant is usually at its best in its second year. A crop planted in the autumn of 1910 or the spring of 1911 would thus be at its best as regards quality in 1913. In 1914 the yield would be larger but the quality would have somewhat depreciated, and it would probably be advisable that the beds should be cleared after this crop has been gathered.

The life of a plantation, however, is largely dependent upon the character of the soil and the amount of manure it has received. On heavy soils plantations are sometimes maintained for a period of five years, although this practice is much less common than formerly, whereas on lighter land three years is the usual limit. No advantage is gained by prolonging the life of a plantation beyond the fourth year, and the more successful cultivators now favour young plantations.

Old beds are often kept for growing strawberries for jam-making.

Gathering and Marketing.

Gathering the Crop.—An average yield of strawberries taken over a series of years may be estimated at 1,000 baskets per acre, each basket containing from 4 to 5 lb. of fruit. Excluding the special prices obtained for the few very early consignments, the price per basket in a good season may be put at 1*s.* 3*d.*, while in a bad season it falls as low as 10*d.* or even less; a fair average under all conditions is probably 1*s.*

The cost of gathering the fruit is an item of considerable expense, and will vary from ¼*d.* to ½*d.* per lb., or, on an average, 1½*d.* per gallon, in addition to which is the expense of carting the produce to rail, freight to market, and saleman's commission.

Marketing.—Where the industry has become extensive, the railway companies usually provide fruit vans for the carriage of the fruit to the large markets, and much may be done in the direction of reducing the cost of transit by small holders combining to send their consignments in large lots.

The varying capacity of baskets and their disposal when empty are matters of some difficulty. In the south of England the slender wicker basket is in common use, but its varying

capacity and the difficulty of estimating the exact weight of contents detracts from its usefulness. The buyer also has objected to the trouble of returning the wicker baskets or paying a charge of 2*d.* in lieu thereof, and a new form of chip basket has been introduced which promises to meet this difficulty. These baskets contain a definite and uniform weight (5 lb.), and it is proposed that they should be sold with the fruit at an inclusive price, a practice largely adopted by the majority of continental growers. The cost of the baskets, which amounts to 1*d.* each when purchased in 50-gross lots, will, it is claimed, be amply covered by the extra price realised owing to the buyers knowing exactly what weight of fruit they are purchasing. Further, many growers maintain that the fruit is damaged during transit when packed in the wicker baskets, their rough and irregular interiors bruising the fruit inside; the chip basket, made of smooth light veneer, obviates this difficulty and presents a much safer and more compact form of package.

Insect and other Pests.

Like all other plants which are raised to a high standard of cultivation, strawberries are assailed by a variety of insect pests, among the most prevalent and destructive of which is the wireworm. Where new ground is broken up and not over-deeply trenched, the grubs commence their ravages on newly-formed plantations, and continue to work havoc among the roots so long as the plantations exist. When new plantations immediately succeed old ones, the young plants are often completely destroyed. Full information respecting wireworms is given in Leaflet No. 10.

Surface caterpillars (Leaflet No. 33) and the caterpillars of the *Common Swift Moth* (*Hepialus lupulinus*) are destructive to underground parts.

The Green Rose-Chafer (*Cetonia aurata*) is also injurious. As a grub it feeds on the roots, while in the adult stage as a beetle it destroys leaves and blossoms. This pest is dealt with in Leaflet No. 25.

The Otiorhynchus Weevils (*O. sulcatus*, *O. picipes*, and *O. tenebricosus*) do considerable damage, the grubs feeding on the roots and the weevils on the shoots and runners. (See Leaflet No. 2.)

Another weevil, *Anthonomus rubi*, known locally as the Elephant, or Snout Beetle, is harmful both as adult and as grub. By means of their proboscis or rostrum the adults puncture the stalk below the flower-buds, causing the latter to droop and become detached; they also puncture leaves and shoots. The grub lives inside the blossom buds, which as a result are destroyed.

The ground Beetles *Pterostichus vulgaris*, *Steropus madidus*, *Harpalus ruficornis*, and *Calathus cisteloides*, feed

at night on the fruits. Occasional damage is done by other beetles and by the caterpillars of some moths.

Slugs and Snails (Leaflet No. 132) are also enemies of the strawberry, both fruit and leaves being attacked.

Eelworms (*Tylenchus devastatrix* Kuhn., and *Aphelenchus fragariae* Ritz. Bos.) also cause much loss among strawberries, the former damaging the roots and crown of the plant, while the latter species causes a somewhat cauliflower-like growth and prevents the proper development of the buds. *T. devastatrix*, the more important species, is dealt with in Leaflet No. 46.

Strawberry Leaf Spot (*Sphaerella fragariae* Tul.) causes dark brown spots to appear on the leaves. These spots gradually increase in size, becoming whitish at the centre and surrounded by a red margin. The leaf then turns yellow and soon dies, and as the disease spreads quickly, much injury follows. As soon as the disease is observed, the plants should be sprayed with Bordeaux mixture—10 lb. sulphate of copper and 8 to 10 lb. of lime in 100 gallons of water. Later in the season, after the fruit has been removed, the foliage should be mown, and allowed to dry; the beds should then be covered thinly with straw and burnt over. This may appear a drastic method, but experience has shown it to be highly successful, and followed by a luxuriant growth of healthy and vigorous foliage. *See also* Leaflet No. 243.

Strawberry Mildew (*Sphaerotheca Castagnei* Lév.) has caused serious loss to strawberry growers during recent years. The fungus completely covers the fruit with a dense white mildew, resembling and closely allied to the summer stage of the American Gooseberry Mildew (*Sphaerotheca mors-uvae*). It is usually only observed by the grower on the fruit, but generally occurs first on the under surface of the leaves, where it is not so conspicuous. Growers should be careful not to overlook this point, but to examine the leaves regularly, as it is only at this early stage that remedial measures can be satisfactorily adopted. Where the disease appears, the plants should be sprayed with Bordeaux mixture (*see* above), and a sprayer which will reach the under surface of the leaves should be employed, while the soil should also be wetted. Where hops are grown, great care should be taken to prevent this fungus spreading to the hops, as it causes hop mildew.

Coloured illustrations of these two fungi are given on No. I. of the seven coloured diagrams of "Diseases of Fruit and Fruit-Bearing Plants" issued by the Board, price 6*d*. each, post free. The diagram is accompanied by a brief account of the diseases.

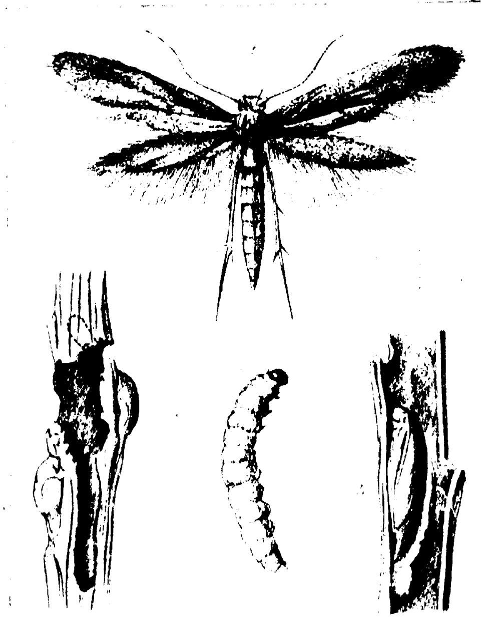
Whitehall Place, London, S.W.,
February, 1910.
Revised, August, 1913.

Leaflet No. 208.

BOARD OF AGRICULTURE AND FISHERIES.

Larch-Shoot Moths.

(*Argyresthia atmoriella*, Bankes; *Argyresthia laevigatella*, Zeller; *Argyresthia zelleriella*, Hartig.)



LARCH-SHOOT MOTH (*Argyresthia atmoriella*).
Fig. 1. Moth (magnified). Fig. 2. Larva (much magnified).
Fig. 3. Pupa. Fig. 4. Form of Burrow.

It is only within comparatively recent years that the small moths known as "larch-shoot moths" have been recognised as a source of injury to larch in this country. They are now known, however, to be widely distributed, and under certain conditions, which will be dealt with subsequently, are capable of causing serious loss.

The species occurring in England is usually known as *Argyresthia atmoriella*, though in a previous edition of this leaflet it is referred to as *Argyresthia laevigatella*, a Continental form not recognised with certainty as British.

There is also an insect known on the Continent as *Argyresthia zelleriella*. These three names refer to moths with similar habits, but whether they should be regarded as a single species remains to be decided. The question is not of great importance from the forestry point of view, but at the same time it should not pass unnoticed, since these insects may be mentioned in literature under any one of the three names, a possibility apt to lead to confusion.

Description of Insect.

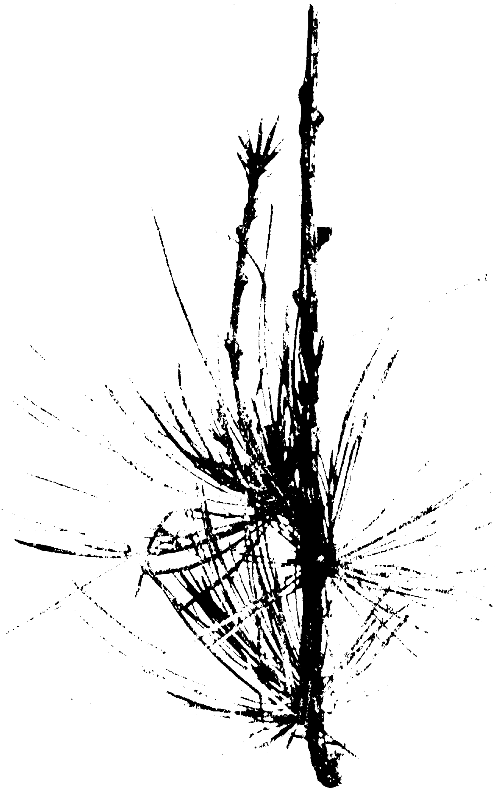
Adult insect.—The moth measures about $\frac{1}{5}$ inch in length and about $\frac{3}{8}$ inch in spread of wings. Its general appearance when magnified is shown by Figure **1**. The colour is leaden grey, the fore-wings having a distinct metallic gloss, while the hind wings are darker and without the gloss.

Larva.—The larva of *A. atmoriella*, when full grown, measures from $\frac{1}{5}$–$\frac{1}{4}$ inch in length and is shown, much magnified, in Figure **2**. It has a black head and the body is either greenish or yellowish in general colour.

Pupa.—The form of the pupa is shown by Figure **3**, which illustrates a specimen in position in a larch shoot. It is pale ochreous brown in colour.

Life History.

The moths appear at the end of May or early in June and lay their eggs on the young shoots, one egg as a rule being placed on each shoot. On hatching the young larva bores its way through the skin of the shoot, under which it begins to feed. At first, owing to its small size, it does little damage, and the shoot is not sufficiently injured to prevent a normal development. As the larva grows it enlarges its burrow, causing more damage to the shoot, and by the end of March or beginning of April it has devoured the tissues right down to the wood, forming a tunnel which may be roughly described as an incomplete spiral,—that is to say, the shoot is almost if not completely ringed. The general form of the burrow is shown by Figure **4**, which represents an attacked shoot, much magnified, from which the bark has been removed in order to show the workings of the larva underneath. The dotted lines indicate the continuation of the burrow on the underside of the twig. In May the larva is full fed and it then bites a small hole through the bark from which the moth will ultimately escape. This flight hole and a portion of the burrow are covered by a thin web and the larva then pupates, as is shown by Figure **3**. On emerging the moth forces its way out through the silk covering over the hole, the empty pupa skin remaining in the burrow.



Branch of Larch attacked by Larch-Shoot Moth.
(*a*) Portion tunnelled by Larva.

Plants attacked and Nature of Damage.

The plants attacked by the pest comprise only those of genus *Larix*, but whether, or to what extent, species other than the European larch are affected, is not at present known.

The nature of the damage is fairly obvious from the preceding description of the life history. The attacked twigs are almost ringed at the end of their first year, and must naturally die, though a few needles may be produced from the lower portion near the flight hole. As a rule the leading shoot is not attacked, but in severe cases this may also occur. Detection of an attack is not always easy, though the absence of needles on the lateral branches gives the tree a

characteristic appearance. Dead shoots which have not been attacked by the insect are often numerous on larch, and the presence of the pest must always be confirmed by the discovery of larval burrows. Small birds seem to have no difficulty in recognising tenanted shoots, which they break open in order to obtain the larvae, and the traces left by the birds are often the most noticeable indication of an attack. The text figure represents an attacked branch, letter *a* indicating the region tunnelled by the larva of the *Argyresthia.* The branch is of interest as showing the development of a secondary shoot to replace that killed by the pest. It is, however, somewhat deceptive, as it appears to be a leading shoot, whereas in reality it is a lateral.

Distribution and Economic importance.

As regards the economic status of the insect, though it appears to exist wherever larch is grown, observations show that it is chiefly destructive in localities not altogether suited to this tree. It must probably be regarded therefore as one of those minor pests which only become of serious importance in plantations enfeebled by other pests, by bad culture, or by an unsuitable environment.

Methods of Control.

The preceding notes show that this pest is best controlled by restricting the planting of larch to localities suited to it.

No treatment can be suggested in the case of an extensive attack, but when a few trees only are affected in an otherwise sound plantation it would be a wise precaution to remove the attacked trees and burn the lateral branches. In the case of single trees of special value or in the nursery it might prove feasible to remove only the attacked twigs. This must be done as soon as failure of the twigs to produce needles in the spring shows that they have been attacked.

Whitehall Place, London, S.W.,
February, 1909.
Re-written, April, 1915.

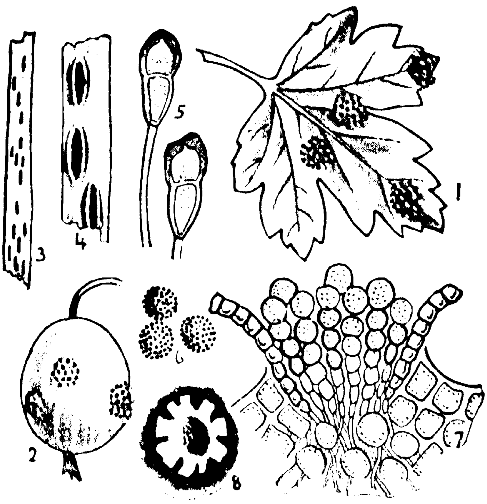
Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 209.

BOARD OF AGRICULTURE AND FISHERIES.

Gooseberry "Cluster-Cup" Disease

(*Puccinia pringsheimiana*, Kleb.).



GOOSEBERRY "CLUSTER-CUP" DISEASE.

1.—"Cluster-cups" on gooseberry leaf (nat. size); 2.—"Cluster-cups" on fruit (nat. size); 3.—Rust stage of fungus on leaf of sedge (nat. size): 4.—Same as fig. 3 (slightly magnified); 5.—Winter spores produced on sedge leaf (highly mag.); 6.—Summer spores from sedge leaf (highly mag.); 7.—Section of a "cluster-cup" (highly mag.); 8.—Surface view of a "cluster-cup" (slightly mag.).

The disease known as Gooseberry "Cluster-Cups" (*Puccinia pringsheimiana*, Kleb.) is one of those diseases which are present during certain seasons in considerable abundance, and then entirely disappear for years. This behaviour on the part of many parasitic fungi is at present inexplicable; there is no reason for suspecting climatic conditions to be the cause, and the requisite host-plants are equally available every season.

The fungus forms bright orange patches on the leaves and fruit, the patches eventually being covered with minute cup-like bodies with white fringed edges and filled with orange-coloured spores.

It has been proved that other stages in the life-cycle of the gooseberry cluster-cup grow on living leaves of sedges

(*Carex*), appearing under the form of minute brown or blackish streaks resembling in general appearance wheat rust (*Puccinia graminis*, Pers.). The winter spores produced on sedge leaves infect gooseberry leaves and fruit, and give origin to the "cluster-cup" form of fruit. Although this is undoubtedly true in some instances, the fact that "cluster-cups" appear on gooseberry bushes growing in gardens far removed from the vicinity of sedges, suggests that under certain conditions the "cluster-cup" condition can directly reproduce itself without the intervention of another form of the fungus, as has been proved to be the case with other rusts.

Prevention and Remedy.

1.—The disease rarely assumes the proportions of an epidemic, and the most satisfactory method of arresting its spread is by collecting and burning infected leaves and fruit.

2.—Sedges growing in the vicinity of gooseberry bushes should be cut and burnt in the spring, before the winter form of the rust matures on the leaves.

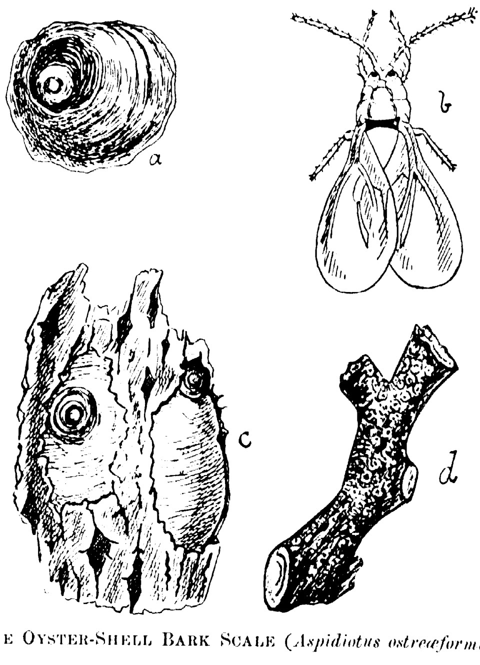
Whitehall Place, London, S.W.,
March 1908.

Leaflet No. 210.

BOARD OF AGRICULTURE AND FISHERIES.

The Oyster-Shell Bark Scale

(*Aspidiotus ostreæformis*).



The Oyster-Shell Bark Scale (*Aspidiotus ostreæformis*).

a. Puparium of adult female from currant (typical form) × 12½; *b*, male × 25; *c*, puparia of mature female on peach, partly buried beneath epidermal layer of bark × 12½; *d*, insects *in situ* on branch of plum, which is almost covered by them. Natural size. (All after Newstead—*A Monograph of the British Coccidæ*, Ray Society, 1900).

The scale insect *Aspidiotus ostreæformis*, whose shield or covering bears, on occasion, a resemblance to an oyster shell, is injurious in Britain to various fruit trees. By draining away the sap the plant is weakened, or, where the scales occur in excessive numbers, it may be killed.

The insect belongs to the family *Coccidæ* or scale insects, and the sub-family *Diaspinæ*. The characteristic of the *Diaspinæ* is that the shield or scale covering the body of the

insect in various stages is composed partly of the insect's moulted or cast skins and partly of matter secreted by the insect. *Aspidiotus ostreæformis* infests apple, pear, plum, cherry and allied rosaceous fruit trees; it has also been found on currant, and Green and Newstead* record it on *Calluna*, heather or ling.

Description.

The following stages occur: egg, larva, second stage of male and female, followed, in the female, by the adult; while in the male the second stage is followed by a pupal stage, this being succeeded by the adult.

Female Scale or Shield.—On smooth bark where not overcrowded, the fully formed shield may have a diameter of over 2 millimetres (say, $\frac{1}{12}$ of an inch). It is round, not much raised, and smooth. The central part of the scale is dark coloured, the rest being yellow-brown or dark grey. Over-crowding causes considerable variation in the shape of the scale. Owing to its flatness and its close adherence to the bark, it may become more or less incorporated with or covered by scales of the epidermis of the plant or loose external matters, and thus, with a colour resemblance to the bark, the scale may easily pass unnoticed.

Adult Female.—The female is flat, almost round, and yellow. In the adult stage the female is without eyes, legs and wings, and has only rudimentary antennæ. There is a characteristic piercing and sucking mouth apparatus.

Male Scale.—The male scale or shield is small, measuring only 1 millimetre (about $\frac{1}{25}$ of an inch); it is rounded oval or, in other cases, elongate oval.

Adult Male.—The adult male insect is orange-yellow in colour, with a dark band across the thorax. The male has antennæ, legs, and two wings, but no functional mouth.

Male Pupa.—The pupa has no mouth organs, but has antennæ, legs, and signs of the future wings. It is yellow in colour, with the eyes and ocelli black.

Second Stage of Male and Female.—The insect in this stage is without wings or legs, being unable to move; it remains anchored to the bark by its rostrum.

Larva.—The larva from the egg is very minute, but is fairly active; a pair of six-jointed antennæ, six legs and sucking mouth apparatus are present.

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* *A Monograph of the British Coccidæ* (Ray Society), by R. Newstead, Vol. i, p. 102.

Life History

The winged males appear towards the end of April or in May, according to the weather conditions. By this time the females are adult and fertilisation takes place. Eggs are laid containing larvæ ready to hatch. The tiny larvæ wander over the bark, ultimately settling down to feed by inserting their sucking mouth parts into the bark. In this larval stage there is practically no sexual distinction. A secretion is given off which covers the larva, and later the first moult takes place and the second stage is attained. The moulted skin is not thrown aside, but remains to form part of the shield or covering of the insect, this covering being greatly added to and completed by secreted matter. This second stage is a quiescent one, but the insect, anchored by its mouth parts, continues to suck up the sap. It is important, from the standpoint of treatment, to note that it is in this second immature stage, complete by the autumn, that hibernation takes place.

About the beginning of the next April, the second stage males pass into the pupal condition, and, after a pupal stage of three weeks, the pupal skin is cast and, in suitable sunshiny weather, the adult males emerge. This last cast skin is to be found for a time at the hind end of the scale. Meanwhile the second stage females—not really differing much from the future adult females—accomplish their last moult and become adult. Pairing then takes place and eggs are subsequently laid, so continuing the species.

Treatment.

1.—All young stock infested should, before being sent out for planting, be fumigated with hydrocyanic acid gas. The form in which *Aspidiotus ostreæformis* is found on plants in winter is one to which this poisonous gas will prove fatal. (See Leaflet No. 188.)

2.—Infested plants, in the open, should be sprayed in winter with a winter wash composed of 2 gallons of paraffin, 1½ lb. of soft soap, 6 lb. of caustic soda, and 28 gallons of water. The soft soap should first be dissolved in 1 gallon of boiling water and to this the paraffin should be added and the mixture thoroughly churned until a cream-like emulsion results. (The thorough churning is important.) The 6 lb. of caustic soda should then be dissolved in the remaining 27 gallons of water and the emulsion added, the whole being well churned. The soft soap and paraffin emulsion will keep satisfactorily for some time, but the complete mixture should be used at once.

3.—A strong paraffin emulsion would kill the scale insects if it reached them. Growers should be guided by circumstances, noting whether the trees carry a growth of lichen or

moss, and remembering also that *Aspidiotus ostreæformis* is a scale which sticks very closely to the bark, and that the external layers of the affected stem may, to some extent, protect the scale. Unless the trees are very clean and fairly smooth the winter wash recommended in the last paragraph should certainly be used.

Whitehall Place, London, S.W.,
April, 1909.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 211.

BOARD OF AGRICULTURE AND FISHERIES.

Cider Orchards.

The general revival of interest in cider-making in recent years suggested that a leaflet dealing with the planting of cider orchards—a somewhat neglected question—and the selection of suitable varieties, would prove useful to a wide circle of growers. Many orchards which are being planted are stocked with varieties reputed to be useful for cider purposes, and of vigorous growth, without any regard being paid to suitable proportions of each kind and similar points of importance from the vintage point of view. The present leaflet is an attempt to deal briefly and practically with these important questions.

Necessity for planting fresh Orchards.

The future welfare of the industry chiefly depends upon a large increase in the planting of fresh orchards during the course of the next few years. Probably the majority of existing orchards have long passed their best days and are now dying out; and few are being planted to fill their places. In unfavourable seasons the supply of fruit is by no means equal to the demand, with the result that prices are high and it is difficult to manufacture *pure* cider at a reasonable profit. The present state of affairs points to a regular and more serious shortage of cider fruit within a few years, and this, unless something be done, means a decline of the industry from the position it now occupies. The matter is so serious that it cannot be too forcibly impressed upon those interested that fresh orchards must be planted, if a suitable supply of fruit is to be maintained. The number of young orchards is small, and enquiries show that the demand for young trees is still limited. It is indeed stated that in many nurseries, where cider trees were formerly extensively raised, their propagation has been given up in consequence of the lack of demand.

Characteristics of a Cider Orchard.

Since it is of importance that fresh orchards should be planted, and since there are indications in some quarters that the need is beginning to be recognised, it may be

opportune to consider what the essential characteristics of a good cider orchard should be from the cider-makers' point of view. The general arrangement and the selection of varieties for a vintage orchard are matters which involve questions of some complexity, quite distinct from those met with in connection with the laying out of orchards for market purposes. It must be borne in mind that the value of an orchard for vintage purposes is determined by the quality of the cider which can be made from its produce ; and the quality is primarily determined by the kinds of fruit and the relative proportions of the three main types of cider fruit, viz., sharp, sweet, and bitter-sweet apples.

The suggestions here made for the construction of a cider orchard have been based to some extent upon the general experience of cider-fruit growers, and are supported by the results of experimental work which has been carried on at the National Fruit and Cider Institute.

Selection of a Site.

An important point to be remembered is that, the more the fruit is exposed to the sun, the better is the quality of the cider. The situation should, therefore, be such that the trees can catch the maximum amount of direct sunlight. A slope facing to the south or south-west is perhaps best. Cider-makers with extensive experience agree that the best and most full-bodied ciders are made from fruit grown on a heavy soil, especially a stiff loam with clay subsoil.

Methods of Planting.

The methods of planting, the distance of the trees from one another, and their general treatment do not differ materially from those suitable for apple orchards in general, details of which will be found in Leaflet No. 134 (*Apple Culture*). It is, however, customary in the West of England to allow cider orchards to become grassed over, even if, as is the rule, they are not originally started on grass land. The fruit, which is commonly gathered by being shaken off the trees on to the grass, can thus be obtained in a reasonably clean condition and free from adherent soil.

Arrangement according to Varieties.

Mixed Orchards are unsatisfactory.—The special feature of a vintage orchard should lie in the selection and arrangement of the varieties of the fruit. Many existing orchards are composed of a very large number of varieties, with but few trees of a kind, some orchards consisting mainly of sharp fruit, and others of sweet or bitter-sweet sorts. Cider made from the produce of any one of such orchards

may be of inferior quality on account of the predominance of one or the other type. To obtain the best results, it is necessary to blend such fruit with fruit of the types which are deficient, obtained from other orchards, or to utilise only a portion of the fruit of the predominating type. Other drawbacks of these miscellaneous orchards are :—(1) All the varieties do not ripen at the same time, the fruit-gathering season in a single orchard being spread over probably the whole cider-making season from September to December, while the orchard is not available for grazing purposes during that period; (2) The tendency is to gather varieties before they are properly ripened, in order to get the orchard cleared of fruit; (3) In gathering, the task of keeping different varieties separate is difficult, if not impossible; (4) There is not a sufficiently large quantity of any of the varieties to enable cider of a regular standard to be made; and (5) The number of varieties utilised for cider purposes is so large, that it is impossible to become properly acquainted with the vintage qualities of more than a few sorts, control of the quality of the product being thus practically impossible.

General Arrangement.—There are clearly then the following points regarding the general arrangement of the orchards which might with advantage be adopted :—

(*a*) *The varieties having different ripening periods should be separated into distinct orchards.* There should be at least three classes of orchards :—(1) *Early*, containing varieties ripening from September to the end of October; (2) *Mid-season*, containing varieties ripening from the end of October to the end of November; and (3) *Late*, containing varieties ripening in December and later. The advantages of such a system are obvious.

(*b*) *The number of varieties should be restricted, but relatively large numbers of trees of the varieties selected should be propagated.* By this means only can the comparative uniformity of a maker's produce from season to season be attained, and that control guaranteed which is the outcome of a thorough knowledge of the qualities of the varieties in use.

(*c*) *The varieties selected for any orchard should be chosen and planted in such proportions that the whole of the fruit grown in that orchard, if mixed together, would yield a good cider, that would not require blending.* The object in view here is to make each vintage orchard self-contained for vintage purposes, and quite independent of other orchards. The advantage to the maker in such a case would be considerable. While the number of varieties which it would be necessary to plant depends upon the characters of those

selected, it would probably be advisable, in order that the total produce might yield a satisfactory blend, not to plant more than three kinds in each orchard,—(1) a sharp, (2) a sweet, and (3) a bitter-sweet variety. There is no necessity to increase the number, for if each of the three types just mentioned is represented, it is possible to obtain a cider of any desired standard of chemical composition simply by the adjustment of the proportion of trees of each kind. In many instances three varieties would not be necessary, as there are several pairs of varieties which go well together, and do not, owing to their chemical composition, require a member of the third class to complete the blend. In certain cases only one variety need be planted, the juice in this instance having a suitable chemical composition without blending. As an example, the Kingston Black variety may be quoted. As a rule, however, a single variety has some element in its composition either superabundant or deficient, and blending is required to correct the proportion.

While these are the general lines upon which the selection and proportion of the varieties may be based, the matter will not be found so simple in practice. For instance, most cider varieties only bear full crops once in two years, and it does not follow that the bearing season for all the trees will be the same. The proportions of fruit of the different classes each season would thus be disturbed, possibly to a serious extent. Again, in bad apple years, sharp and sweet cider varieties are usually sold largely for market purposes and for jam making, thus causing a preponderance of bitter-sweets for cider making. This, however, could not be avoided under any arrangement, and the simplest way out of the difficulty would appear to be to reduce the planting of the bitter-sweet types to the lowest practical proportions. Such an arrangement represents a considerable advance beyond the usual method; and whether or not the cider maker may eventually decide to make all varieties up separately, and to blend the juices or the ciders instead of the fruit, as at present practised, the fact that the produce, as a whole, of a single orchard could be relied upon approximately to yield a good cider, would facilitate matters considerably.

(*d*) *Trees of the same variety should be planted in blocks or groups.* Undoubtedly the most scientific method of dealing with fruit for vintage purposes is to have the different kinds gathered and kept separately, so that the maker can either mix the fruit himself in the proportions which he desires, or can press each sort separately, and blend the liquor afterwards. By planting comparatively few varieties, but a large number of trees of each sort, and by

grouping trees of one sort together, it will become perfectly practicable to deal with the fruit in this manner.

It has been shown that some varieties are self-sterile, and that cross-fertilisation is necessary in such cases. It is therefore important that too large a number of trees of any one kind should not be planted in proximity.

Method of selecting Varieties.

Coming now to the varieties themselves, it follows from what has been said above that at least nine different sorts or types are required, viz., a "sharp," "sweet," and "bitter-sweet" for early, mid-season, and late orchards. To these might be added those varieties which yield a good cider without blending; but since they can also be included either among the "sweets" or the "medium sharps," it is hardly necessary to deal with them separately here.

Necessary Characteristics.—In making a selection of the best varieties of each type, not only must the usual characters of growth, cropping qualities, resistance to disease, and so on, be taken into consideration, but there are also special characters of vintage importance to be estimated. One of the chief of these is *the characteristic flavour of the variety*, a factor which is frequently sufficiently pronounced materially to affect the value of a cider. Two kinds of apples may have approximately the same chemical composition, and may yield the same type of cider, and yet the values of the two ciders may be widely different, owing solely to the difference in flavour of the two sorts. This feature is usually much more strongly marked in the case of sharp varieties than with other kinds.

Another most important factor is *the rate of fermentation of the juice*. Owing to a number of causes this differs to some extent even with the same variety, but, generally speaking, the whole of the available evidence points to the conclusion that under normal conditions some varieties yield slowly-fermenting juice, others give juice fermenting at a moderate rate, and others again produce juice capable of rapid fermentation. The general experience of cider-makers goes to show that members of the latter class are undesirable, since only a dry cider can be obtained from them by natural means. The flavour also is usually coarse. The other two classes are useful, the slowly-fermenting juices being naturally adapted for the production of sweet ciders, and those fermenting at a moderate rate being suitable for the preparation of dry, medium, or moderately sweet ciders.

Varieties which yield juices subject to an excessively slow fermentation should not be planted too extensively, since the ciders made from them are particularly liable to

certain disorders, as, for example, cider sickness. If, however, a supply of more rapidly-fermenting juice is available for blending, such varieties may be utilised with safety.

Other important points in connection with the selection of varieties are: (*a*) *the yield of juice*, which frequently varies by as much as 10 to 15 per cent. of the weight of the fruit in the case of different varieties; and (*b*) *the degree of firmness of the flesh*, hard-fleshed varieties being less easily bruised in gathering and handling than soft-fleshed kinds, and, therefore, less liable to decay and to the consequent taint in flavour, while they are more suited for storage when that is necessary.

Grouping Varieties in a Series of Orchards.—In cases where it is proposed to plant a series of orchards, the idea of grouping the varieties, not only by their ripening periods, but also by their relative rates of fermentation, would be worth consideration. Thus there might be orchards, the produce of which would yield either a sweet or a dry cider, whether consisting of early, mid-season or late varieties. Some arrangement of this nature would certainly tend to simplify matters for the cider-maker, and would probably add to the value of the orchards from the growers' point of view, since a definite idea of the quality of the produce of such orchards for cider-making purposes could be formed, and better prices for the fruit would be obtainable, just as at the present time better prices can be obtained for fruit of recognised value than for mixed fruit, about which little is known.

Useful Varieties.

Concerning individual varieties which can be recommended for propagation, any list which is given must be regarded as provisional only. The experimental work at the National Fruit and Cider Institute on the vintage qualities of different varieties of repute has shown that many kinds have been rated hitherto above their real value, and that there are in existence several comparatively or absolutely unknown sorts, which appear to be of superior quality, so far as can be judged from the limited experience of them which it has been possible to gain since the commencement of the work seven years ago. A very large number of varieties has been tested, and the most promising kinds are being propagated at the Institute. Conclusive results cannot be obtained for several years, but meanwhile growers may be glad to have some guide as to the most suitable varieties to plant. The following list has therefore been drawn up and contains representatives of each class required. All of the varieties named are not necessarily the best of the kind which are to be found, but every variety mentioned has been tested at the National

Fruit and Cider Institute, and is decidedly above the average of its class in quality. Superior varieties will no doubt be found after further research.

Varieties recommended for Propagation.

—	Sharp Varieties.	Sweet Varieties.	Bitter-sweet Varieties.
Early ...	Backwell Red. Dymock Red. Sams Crab.	Belle Norman. Horners. White Jersey. (All mild bitter-sweets.)	Cherry Norman. Knotted Kernel. White Norman.
Mid-season	Cap of Liberty. Cherry Pearmain. Dufflin. Foxwhelp. Frederick. Kingston Black. Yellow Styre.	Sweet Alford. Burstout. White Alphington. Eggleton Styre.	Major. Masters Jersey. White Close Pippin. Twistbody Jersey.
Late ...	Lambrook Pippin. Porter's Perfection. Broad Styre.	Bell. Woodbine. Slack-ma-girdle.	Chisel Jersey. Dabinett. Royal Jersey. Strawberry Norman. Royal Wilding. Fréquin Audièvre.

Many of these kinds are not at present obtainable from nurserymen; but all are being propagated at the Institute, and in due course the trees will be available for distribution. The best plan for those who wish to grow them at once will be to graft such sorts on the heads of young standard trees of other varieties; and it is probable that this method should be regularly adopted for weak-growing varieties, such as Kingston Black, a strong-growing variety being selected for the standard.

Re-planting Old Orchards.

The question of re-planting old orchards needs careful consideration. It is customary in many districts to fill up gaps in old orchards by planting young trees in the place of the old ones which have died off. In some instances, when an old orchard is worn out, the trees are grubbed up and their places filled with young standards. This plan cannot be recommended when it is possible to obtain fresh land for planting. In the first place, the young trees rarely, if ever, make such good growth as they would if planted in new land, even though all the old trees have been removed; and, secondly, there is great risk of infection of the young trees by insect and fungus pests. Most old orchards are hot-beds of pests of various descriptions, and although all old trees may be removed, the soil will certainly remain

laden with the pests. The whole question of the extension of orchard planting is thus finally reduced to one of finding fresh land available for the purpose.

.Though the planting of young trees in old orchards is, therefore, not a practice to be recommended if fresh land can be obtained, growers are frequently obliged to fill up gaps in old orchards. In such a case, if the orchard concerned be composed almost entirely of old trees likely to die in the course of a few years, the young trees planted as the vacancies arise should as far as possible be placed so as to fall into proper position relatively to the young trees which will eventually replace the remaining old trees.

Where gaps are to be filled in comparatively young orchards there is not generally the same degree of choice of position available, since the existing trees may last for several years and the available area for the selection of a site is therefore restricted within narrow limits.

In any case, however, it will be well if each new tree can be planted in such a way that it will not occupy the same spot as its predecessor; and in such instances the planting may be done in the usual manner.

Where, on the other hand, a new tree will occupy the same ground as the old, special preparation of the soil should be attempted. The roots of the old tree should be first removed as completely as possible, in order that no decaying wood may be left in the soil, and a circular hole, at least six feet in diameter and from 1½ to 2½ feet in depth, should be dug and left open to atmospheric influences as long as possible before the tree is planted. The soil may also be sweetened and freed as far as possible from insect and fungoid pests by a dressing of quicklime. If fresh soil can be obtained to substitute for that dug out, the newly planted tree will have a better opportunity to flourish. Should the orchard happen to be on grass land, it will be an aid to the tree, also, if the grass be not allowed within 3 or 4 feet of it for the first few years after planting.

Whitehall Place, London, S.W.,
April, 1908.
Revised, November, 1912.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 212.

BOARD OF AGRICULTURE AND FISHERIES.

Railway Fires Act, 1905.

The Railway Fires Act, 1905, provides that, when damage is caused to agricultural land or to agricultural crops by fire arising from sparks or cinders emitted from any locomotive engine used on a railway, the fact that the engine was used under statutory powers shall not affect liability in an action for such damage, but this provision does not apply in the case of any action unless the claim for damage is £100 or less.

The expression "agricultural land" includes arable and meadow land and ground used for pastoral purposes or for market or nursery gardens, and plantations, woods and orchards, and also includes any fences on such land, but does not include any moorland or buildings; and the expression, "agricultural crops" includes any crops on agricultural land, whether growing or severed, which are not led or stacked.

Section 2 provides that a railway company may enter on any land and do all things reasonably necessary for the purpose of extinguishing or arresting the spread of any fire caused by sparks or cinders emitted from any locomotive engine.

It also provides that a railway company may, for the purpose of preventing or diminishing the risk of fire in a plantation, wood, or orchard, enter upon any part of the plantation, wood, or orchard, or on any land adjoining thereto, and cut down and clear away any undergrowth, and take any other precautions reasonably necessary for the purpose; but they must not, without the consent of the owner, cut down or injure any trees, bushes or shrubs.

A railway company exercising powers under this section must pay full compensation to any person injuriously affected by the exercise of those powers, including compensation in respect of loss of amenity.

The Act does not apply in the case of any action for damage by fire brought against any railway company unless notice of claim and particulars of damage, in writing, shall have been sent to the railway company, within seven days of the occurrence of the damage as regards the notice of claim, and within fourteen days as regards the particulars of damage.

Light railways and tramways worked by steam power are within the scope of the Act.

Whitehall Place, London, S.W.,
September, 1908.

Revised, June, 1910.

Leaflet No. 213.

BOARD OF AGRICULTURE AND FISHERIES.

Gooseberry Black-knot (*Plowrightia ribesia*, Sacc.).

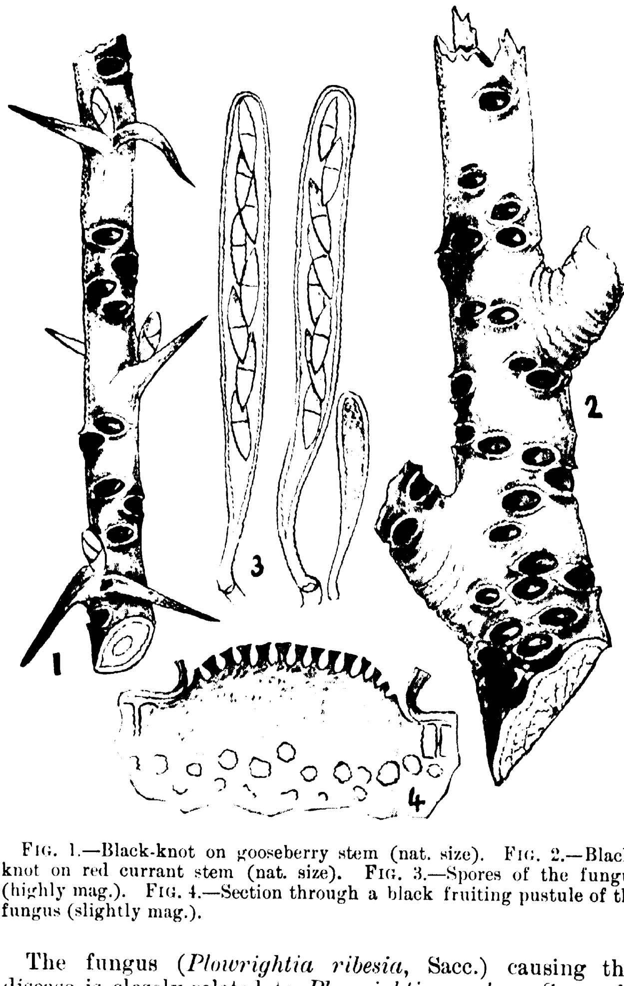

FIG. 1.—Black-knot on gooseberry stem (nat. size). FIG. 2.—Black-knot on red currant stem (nat. size). FIG. 3.—Spores of the fungus (highly mag.). FIG. 4.—Section through a black fruiting pustule of the fungus (slightly mag.).

The fungus (*Plowrightia ribesia*, Sacc.) causing this disease is closely related to *Plowrightia morbosa*, Sacc., the widely distributed "black-knot" of plum and cherry trees in the United States and Canada.

P. ribesia attacks the stem and larger branches of the gooseberry and of red and black currant bushes in this country, and it is not uncommon to find the disease in neglected gardens, more especially where currant scale or aphides are present in quantity. The fungus is a wound-parasite, since spores placed on an unbroken surface produce no result, whereas infection follows when spores are placed in a minute wound in the bark. It seems probable that aphides or scale insects enable the fungus to gain an entrance to the living tissues of the plant, as in the case of larch canker, apple-tree canker, &c.

Signs of Disease.

1.—The first indication of disease is the wilting and yellowing of the leaves, which fall quite early in the season. As a rule, a branch is not killed outright in the first season of the attack, but during the second year the leaf-buds remain in a half-opened condition and the branch dies, owing to the presence of the fungus *mycelium* in the conducting vessels preventing the ascent of water in the branch.

2.—The fungus does not show itself externally until the branch is dead, or nearly so, when its fruiting bodies burst through the bark under the form of large elongated and transversely grouped black warts. These warts are often quite numerous and give a blackened appearance to the branch.

Treatment.

1.—Spraying is of no avail in the case of this fungus.

2.—On the first appearance of disease, indicated by wilting of the foliage, infected branches should be removed and burned.

3.—Bushes should be kept clear of aphides and currant scale.

Whitehall Place, London, S.W.,
July, 1908.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 214.

BOARD OF AGRICULTURE AND FISHERIES.

Co-operative Agricultural Credit Banks.

A Credit Bank is a co-operative society, usually consisting of persons in a small way of business, which obtains advances of capital on the joint security of its members, and lends out to them small sums of money from time to time for productive purposes.

A business man of any standing in the commercial world experiences little difficulty in obtaining temporary advances of money to meet special requirements, but the small man in an agricultural community does not, as a rule, possess the same facilities. In the days when private banks were scattered up and down the country the position was somewhat different. A trustworthy man could then more easily obtain a credit accommodation merely on the security of his character and position. With the gradual absorption of private firms into large Joint-Stock Banks conditions have changed, and, in addition to the small farmer, Credit Banks are intended to assist the labourer or farm-servant with his allotment, the market gardener and the village tradesman, who may not be in a position to borrow money through the ordinary channels of credit, because ability, experience, and honesty of character do not necessarily constitute a sufficiently acceptable security for an advance.

A Credit Bank, however, is not a philanthropic institution, but a society based and conducted strictly upon business principles. The distinctive features of a Credit Bank are :—

(i.) It is co-operative—its key-note being "self-help" and mutual responsibility.

(ii.) It is local—its members living within a small area and being well known to one another.

These two essential features will become clearer when we proceed to consider its

Constitution and Operations.

The village or parish is the most convenient unit of area for a Credit Bank. Its successful institution does not depend entirely upon economic and financial considerations. Speaking generally, however, the most favourable conditions for starting a Credit Bank are to be found where there are a considerable number of persons of about the same

economic position. Where a sufficient number of such persons can be found who are willing to combine to secure the advantages of co-operative credit they can form themselves into a society, adopt the necessary rules, and be duly registered under the Friendly Societies Act, 1896, as a "specially authorised society," for the purpose of creating funds by monthly or other subscriptions, to be lent out to or invested for the members of a society, or for their benefit, pursuant to the provisions of the Act. If such a society divides no profit amongst its members, and approves the purpose to which the money lent is to be applied, it is entitled, under the Societies Borrowing Powers Act, 1898, to make a rule authorising it to borrow money from any person whether a member or not.

Full information as to the proper procedure can be obtained, as regards England and Wales, from the Chief Registrar of Friendly Societies, 28, Abingdon Street, Westminster, S.W., and as regards Scotland from the Scottish Registrar of Friendly Societies, 3a, Howe Street, Edinburgh. The Agricultural Organisation Society, Queen Anne's Chambers, Westminster, S.W., will also supply model rules on application, and is willing to conduct the necessary proceedings as to the registration of Credit Banks in England and Wales. Persons residing in Scotland should communicate with the Scottish Agricultural Organisation Society, whose address is 5, St. Andrew Square, Edinburgh. Information as to existing Credit Banks in Great Britain can be obtained from these sources.

The Credit Bank, as soon as it is properly constituted and registered, and its officers and committee of management are appointed, is in a position to borrow money on the joint security of its members and to lend it out to those of them who are at the moment in need of ready money. An applicant must satisfy the committee that his case is a suitable one for an advance, and that the purpose for which he requires it is such as to afford a reasonable security for the repayment of the money by a given date.

The Credit Bank will only lend money for productive purposes, that is to say for purposes that are likely to place the borrower in an improved economic position. This, however, allows it a wide field of action. To give but a few examples of the useful objects for which money might be advanced there may be mentioned the purchase of implements, seeds, manure, poultry, live-stock, &c., or the erection of a fowlhouse, greenhouse, or pigsty. A member who wishes to borrow money must state the purpose for which he requires it, and must undertake to apply it to that particular purpose. It will then be within the discretion of the committee to decide whether the loan shall be granted or not.

A Credit Bank can only lend to its own members, and its success will depend upon its admitting as members only those whose industry, honesty, and integrity are beyond question. A person who possesses these qualities should have no difficulty in becoming a member of a Credit Bank, or in obtaining from it an advance of money for any useful and productive purpose. The Bank, however, will require an applicant for a loan to offer in addition to his own personal security that of one or two other persons who are willing to guarantee to repay the loan should the applicant fail to do so.

The Credit Bank is a self-governing institution. The members elect the necessary officers and committee to manage its affairs, and as each member is responsible for the repayment of money borrowed for the purposes of the society it will be to his interest to see that the character of the membership is strictly maintained, and that the affairs of the Bank are conducted in an efficient and businesslike manner. This is of great importance, for the success, not only of any individual bank but of the whole system of co-operative credit, depends upon the principle of mutual responsibility being fully recognised.

This interest in good management will be all the more vital to success because a Credit Bank of the type here described must be necessarily conducted upon the principle of the

Unlimited Liability.

of its members for the money borrowed by the Bank. It is this feature that constitutes the security upon which the Bank can obtain money at a low rate of interest.

Lest this should cause any misgivings as to the risk of loss incurred by the individual members, it should be pointed out that such risk is guarded against through the effective control which the members can exercise over all transactions of the Bank.

Further, the possibility of loss is very greatly reduced if a rule is adopted limiting the total amount of money that can be advanced by the Bank and the amount that can be lent to any one member each year. Section 46 of the Friendly Societies Act provides that a society shall not make any loan to a member on personal security beyond the amount fixed by the rules, or make any loan which together with any money owing by a member to the society exceeds £50.

Notwithstanding the greatest care in management it would seem that there still remains a risk of bad seasons, loss of crops or stock, or a fall in prices, preventing the prompt repayment of advances. Such contingencies cannot be foreseen or effectively guarded against, and when they occur

Credit Banks will not be the only institutions affected. It would seem to be good policy to aim at building up a reserve fund sufficient to tide the Bank over times of difficulty due to the causes mentioned.

How very remote the risk of loss really is may be judged from the fact that in Germany, where there are a very large number of societies, it is said that no depositor or other creditor has lost a farthing since the movement was started in 1849.

Deposits, Entrance Fees and Subscriptions.

To every Credit Bank there should be attached a department for receiving on deposit the savings of its members. The sums thus received, together with members' entrance fees and subscriptions, would supplement the sources from which money can be borrowed by the Society, and therefore would assist its lending operations.

Interest on Loans.

Credit Banks do not distribute dividends, and, the expenses of management being very small, they are able to achieve one of their main objects by being in a position to lend money at a moderate rate of interest.

Central Bank.

As Credit Banks are started in various localities they can strengthen their position and increase their resources by obtaining loans through a Central Bank. Such Central Bank could then receive on deposit any surplus funds from the local banks, besides assisting them if necessary by making advances. It would, in fact, stand in somewhat the same relation to the local Credit Banks as these would to their individual members. The principle of unlimited liability, however, which is essential in the case of the separate banks, would be generally unsuitable as regards their relation to the Central Bank.

In connection with the Village Co-operative Credit Societies affiliated to the Agricultural Organisation Society, a Central Co-operative Agricultural Bank has been formed.

Small Holdings and Allotments.

The useful part which Credit Banks may play in the successful cultivation of small holdings and allotments has been recognised by Parliament, which has included in the Small Holdings and Allotments Act of 1908* certain provisions relating to these and other co-operative institutions.

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* **N.B.—This Act does not apply to Scotland.**

County Councils in England and Wales are given power under the Act to promote the formation and extension of Credit Banks, and they may, with the consent of the Local Government Board, assist such societies by making grants or advances upon such terms and such security as the Council think fit. Even if they do not themselves lend money, County Councils may guarantee advances made to the Credit Bank from other sources, and, the credit of a County Council being a first class security, this provision should prove quite as useful in practice as the one enabling the Councils to advance money themselves.

Whitehall Place, London, S.W.,
November, 1908.
Revised, August, 1910.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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Leaflet No. 215.

BOARD OF AGRICULTURE AND FISHERIES.

How to obtain an Allotment or a Small Holding.

The object of this leaflet is to give those who desire to secure an allotment or a small holding from the Local Authority some information as to what they should do in order to obtain land, and as to the conditions under which land can be acquired. The leaflet has nothing to do with small holdings or allotments provided by private landowners, but is concerned only with those that can be provided by Local Authorities under the Small Holdings and Allotments Acts.

ALLOTMENTS.

Definition and Method of Application.

An allotment may be of any size up to five acres.

Applicants in rural parishes should write to the Clerk of the Parish Council, or to the Chairman of the Parish Meeting if there is no Parish Council, and applicants in urban districts should write to the Clerk of the Urban District Council or the Town Clerk as the case may be. They should state the amount of land required and whether arable or grass, and if any particular piece of land is desired it should be mentioned.

It does not follow that the Council will be able to obtain this particular land, but the information furnished will be of use to the Council by enabling them to meet the wishes of applicants as far as possible.

Where rules have been made by a Council as to the manner in which applications are to be made, the rules should be carefully observed.

Tenure.

Allotments cannot be sold to applicants but may only be let. No allotment may be sublet. Allotment tenants are entitled, on quitting their allotments, to compensation for unexhausted improvements under the Agricultural Holdings Acts, or under the Allotments and Cottage Gardens Compensation Act, 1887.

Powers and Duties of Local Authorities.

Allotment authorities can let land only to members of the labouring population resident in their parish, district, or borough. Women as well as men are eligible as tenants of

allotments. The term "labouring population" may be taken to include all those persons whose main occupation involves manual labour and would embrace most persons to whom an allotment would be useful. But, if an applicant does not belong to the labouring population and requires more than one acre of land, he can apply to the County Council under the Small Holdings Acts. Allotment authorities may provide allotments up to five acres in extent for one individual, but they are not obliged to provide allotments of more than one acre. If, therefore, an applicant desires more than one acre and the allotment authority declines to take action, he should apply to the County Council for a small holding under the Small Holdings Acts (*see* next page).

If a Parish Council or Parish Meeting, or a District Council (not being a Borough Council) fail to carry out their obligation to satisfy the demand for allotments in their district, the County Council are empowered to provide allotments up to one acre at the expense of the defaulting authority, and the Council can deal with applications for over an acre under the Small Holdings Acts. If the County Council fail to act, the matter may be referred to the Board of Agriculture and Fisheries.

Acquisition of Land by Local Authorities.

A local authority can purchase or hire land for allotments either within or outside the parish, district, or borough, and can adapt such land for the purpose. They are also empowered to erect a dwelling house for occupation with any allotment of one acre and upwards. If a Borough or District Council cannot acquire land by agreement, they may purchase or hire land compulsorily subject to certain restrictions, one of which is that no part of any holding of fifty acres or less can be compulsorily acquired. The purchase money or rent of land acquired in this way will be fixed by an independent arbitrator or valuer. In the case of a Parish Council or Parish Meeting being unable to obtain land for allotments by agreement with the landowners, the Council or Meeting can represent the case to the County Council, who may thereupon proceed to acquire land compulsorily on behalf of the Parish Council or Parish Meeting. In every case, however, a compulsory order must be confirmed by the Board of Agriculture and Fisheries before it can take effect.

Rent.

The rents to be charged to allotment holders will be fixed at sums sufficient to cover the expenses incurred in providing the allotments, such as the purchase money or rent paid by the local authority for the land, the cost of adaptation, &c., and the expenses of management. If a house is erected on the allotment additional rent will be charged to cover the cost. A Council is entitled to require the payment of one quarter's rent in advance.

SMALL HOLDINGS.

Definition and Method of Application.

A "small holding," for the purposes of the Small Holdings Acts, means an agricultural holding which is more than one acre and not more than fifty acres in extent. It may, however, exceed 50 acres provided the annual value for the purpose of income tax is not more than £50.

Applications for small holdings should be made to the Clerk of the County Council, or, in the case of residents in a County Borough, to the Town Clerk. The form of application issued by the Council should be used.

Persons eligible as Applicants.

There is no restriction in the Small Holdings Acts as to the class or sex of persons that may apply to small holdings, except that they must "themselves cultivate the holding." This expression is not to be understood in a narrow sense. The Acts define "cultivation" to mean the use of land for any purpose of husbandry, including the keeping or breeding of live stock, poultry, or bees, and the growth of fruit, vegetables, and the like. Applicants will be expected to satisfy the Council that they have sufficient experience and means to work a small holding with the prospect of success. There is no provision in the Acts for the advance of money out of public funds to individuals taking up small holdings.

Acquisition of Land.

Councils can purchase or hire land for small holdings either within or without the county or borough. If they are unable to obtain land by agreement, they can, with the sanction of the Board of Agriculture and Fisheries, acquire land compulsorily subject to the restrictions referred to in the case of allotments.

Councils have certain powers of adapting land for the purpose of small holdings, including the power to erect dwelling houses and other buildings.

Sale or Letting of Small Holdings.

Land that has been bought by a Council by agreement can either be sold or let to a small holder, but land taken on lease, or acquired compulsorily, can only be let.

Rent.

The rent to be paid by a small holder will be fixed by the Council at a sum not less than is sufficient to cover the rent or the interest on the purchase money paid by the Council, with the addition of a due proportion of the cost of adapting the land for small holdings, and a sum to cover management and other expenses. Tenants will be expected to pay their own rates.

Terms of Purchase.

The terms upon which a small holding may be purchased are as follows:—

At least one-fifth of the purchase money, including the cost of adaptation, must be paid down. One-fourth may be secured by a perpetual rentcharge, and the payment of the remainder of the purchase-money, together with interest, will be made in half-yearly instalments which may be spread over a period not exceeding fifty years.

Every small holding sold by the County Council will, for twenty years, and thereafter until the whole of the purchase money is paid, remain subject to certain conditions drawn up to ensure that the holding shall not be diverted from the purpose of agriculture.

Assistance to Small Holding Tenants to buy their Holdings.

If the tenant of a small holding under a private landlord agrees with him for the purchase of the holding, the County Council may advance not more than four-fifths of the purchase-money. The money is repayable to the County Council upon the same terms as in the case of a small holding sold by the Council, and the holding will become subject to the same conditions.

Letting to Associations.

Councils may, with the consent of the Board of Agriculture and Fisheries, let land for the purposes of small holdings or allotments to registered associations complying with certain rules.

Persons desiring to form such an association and to acquire land from a Council for the purpose of sub-letting it in small holdings or allotments to the members of the association or others should communicate with the Secretary of the Agricultural Organisation Society, Queen Anne's Chambers, Westminster, S.W., with a view to their adopting the necessary Rules and becoming registered societies.

Whitehall Place, London, S.W.,
August, 1908.
Revised, December, 1908.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 216.

BOARD OF AGRICULTURE AND FISHERIES.

The Administration of the Small Holdings Acts.

A "small holding" for the purposes of the Small Holdings and Allotments Act, 1908 (which consolidates the existing Acts relating to the provision of small holdings in England and Wales), means an agricultural holding which is more than one acre and not more than fifty acres in extent. Its area may, however, exceed fifty acres, if its annual value for the purposes of income tax is not more than fifty pounds.

The local authorities directly responsible for the provision of small holdings in England and Wales are the County Councils and the Councils of County Boroughs.

Appointment of Small Holdings and Allotments Committee.

The first step to be taken by a Council to bring the Act into operation is the appointment of a Small Holdings and Allotments Committee, which may include non-members of the Council.

The Council may delegate all their powers under the Act to the Committee, except the power of raising a rate or of borrowing money, and, with a view to avoiding unnecessary delay, it is desirable that full powers should be delegated, and that the Committee should be authorised to conduct all correspondence relating to the Act, to carry out inquiries, and to negotiate for the acquisition of land, without having to refer each point to the Council.

In the case of a County Borough, the members of the Committee might conveniently be appointed allotment managers under Part II. of the Act, which relates to allotments.

Applications.

After Councils have made known the provisions of the Act throughout the county or borough by advertisement, &c., applications should be invited, and forms of application supplied, which should contain inquiries as to the experience of the applicant, and whether he or she has sufficient capital to work the holding with a reasonable prospect of success.

Applicants should also be asked to state in the form of application how much land they desire, and whether arable or grass, whether they desire to purchase or hire the land, whether they require a house or buildings, whether they desire any particular land, if it can be obtained for them, and whether they are occupying any land at the time of making application. The Board are authorised to repay one half of the expenses incurred by a Council up to the 31st March, 1910, in ascertaining the demand for small holdings in the county or borough.

Rules.

Rules for the sale and letting of small holdings are required to be made by Councils. These rules must be confirmed by the Board of Agriculture and Fisheries, who have issued model rules for the information and guidance of Councils.

Inquiries as to Suitability of Applicants.

On the receipt of applications for land a Council should satisfy themselves as to the qualifications and suitability of the applicants by means of inquiries at which the latter can be interviewed personally. For this purpose the best course will be to appoint sub-committees, consisting partly of members of the Small Holdings Committee, and partly of members of the minor local authorities and other suitable persons, for each parish or other convenient area from which applications have been received.

In dealing with the applications it will be necessary to consider the provisions contained in sections 1, 7 and 12 of the Act of 1908, which require that "applicants must themselves cultivate the holdings." It seems clear that these provisions are intended to be read with sec. 10 of the Act, which requires the Council to make rules guarding against any small holding being held by a person who is unable to cultivate it properly, the object being to secure that the small holder shall personally apply the requisite skill and ability to the cultivation of the holding.

The words should not be interpreted in a narrow sense, and persons who require land as an adjunct to their present occupations should not be refused on that account, nor should their applications be given a secondary place as compared with those of men who propose to devote their whole time to their holdings. In this connection it should be remembered that sec. 61 of the Act of 1908 defines "cultivation" to include the use of land for any purpose of husbandry, inclusive of the keeping or breeding of live stock, poultry, or bees, and the growth of fruit, vegetables, and the like. The provision that the small holders must themselves cultivate their holdings does not exclude the use of hired labour to assist them in the cultivation.

Appointment of a Special Officer.

If the work of the sub-committees is to be carried out properly it will probably be found necessary for the Council to appoint a special officer to act as their land or estate agent, and to deal with the business arising under the Act. Such an officer could act as clerk to the Small Holdings and Allotments Committee, and he might also be responsible for attending and reporting the meetings of the local sub-committees, and for making such inquiries as the Committee might direct into the suitability of the applicants for land and the best means of meeting their demands. In addition, he could undertake the management and supervision of the small holdings, when established, and the collection of the rents, and could act generally as the estate agent of the Council for all the land acquired by them under the Act.

Acquisition of Land by Agreement.

When the Council are satisfied that there are suitable applicants, it will be necessary for them to consider how they should proceed to obtain the land to satisfy their

demands. For this purpose a look-out should be kept for any forthcoming sales of property in the county. It may be desirable to ascertain from the local landowners whether they are willing to offer to the Council any farms which may become vacant, and inquiry might also be made as to the possibility of purchasing or hiring some of the glebe lands attached to benefices. Land may be acquired either within or without the county. In considering the question of acquiring any particular land, the Council will have to decide whether the land should be purchased or hired, and, in cases where any considerable amount will have to be spent on equipment, there are obvious advantages in the purchase rather than the hiring of land, in order to avoid the difficult question of compensation for improvements, as between the Council and the landlord, at the termination of a lease which may not be renewed, and the necessity of imposing high rents to cover the replacement, in a comparatively short period, of money spent on improvements.

It will also be necessary for the Council to decide whether they propose to acquire the land under a scheme or not. It is open to a Council to proceed without a scheme, but if this course is adopted no claim can be made by the Council for the repayment out of the Small Holdings Account of one half of any loss which may be incurred (*see* page 6). If it is decided to proceed under a scheme, a contract for the purchase or hiring of the land, conditional if possible on the scheme being approved and the loan (if any) being sanctioned, should be entered into, and a report should be prepared by the Small Holdings Committee containing the following information :—

(1.) The situation, quantity and description of the land to be acquired, the gross estimated rental and rateable value, the amount of the valuation (if any) and the proposed purchase price or rent.

(2.) The maximum amount to be expended on adaptation and equipment, with particulars of the work proposed, but not, in the first instance, plans or specifications.

(3.) The manner in which the land is proposed to be sub-divided.

(4.) The purchase price or rent proposed to be charged for each holding.

The report should also state whether the Council are satisfied that there are suitable applicants ready to take the land at a sufficient price or rent to recoup the Council for the outlay proposed, and an Ordnance Map, or a tracing therefrom, should be prepared showing the holdings into which it is proposed to divide the land.

The detailed information in the report, together with the plan, should then be sent to the Board of Agriculture and Fisheries for their provisional sanction of the scheme, and when this has been given the proposed scheme must be

advertised in accordance with sec. 5 of the Act of 1908. For this purpose it will be sufficient if a notice in the following form is inserted in one or more of the local newspapers circulating in the county or borough :—

Small Holdings and Allotments Act, 1908.

Notice is hereby given that a draft scheme has been prepared by the Council for the acquisition on lease / by purchase of for small holdings. Information as to the contents of the draft scheme can be obtained from the Clerk of the Council. Any objection to the draft scheme is to be sent in writing to the Board of Agriculture and Fisheries within one week from the date of the publication of this Notice.

If no objections are received the Board will then proceed to confirm the scheme, and the Council will be able to complete the contract.

If it is desired to purchase land at a sale by auction the Council should obtain a report and valuation of the land, a copy of which should be sent to the Board. If the report and valuation prove satisfactory, the Council might instruct an agent to bid up to the amount authorised by the Board. If the land is acquired a scheme can then be prepared and submitted to the Board, who have stated that, in cases where it has not been possible to obtain their sanction before the completion of the contract, they will be ready to consider a subsequent application for their approval to the scheme.

Compulsory Acquisition of Land.

Extensive powers of leasing land to Councils for small holdings and allotments are given by the Act to incumbents and other limited owners, but cases will occur in which Councils will be unable to obtain suitable land for small holdings by agreement, and they must then consider whether they should not submit to the Board an Order authorising them to acquire land compulsorily. If they decide to do so they must select the land which they propose to acquire, and, in this connection, it must be remembered that no holding of 50 acres or less, no land which forms part of a park, garden, or pleasure ground or of the home farm of a mansion house, or which is otherwise required for the amenity or convenience of a dwelling-house, and no land which has been acquired by a local authority or statutory corporation or company for a public undertaking, can be acquired compulsorily. Further, the Council should not lose sight of the fact that they must, so far as practicable, avoid taking an undue or inconvenient quantity of land from any one owner or tenant, and that if it is proposed to acquire part only of a holding, a claim for compensation for severance may arise, which will have the effect of increasing the price or rent to be paid for the portion taken.

Having decided upon the land to be acquired, the Council must make an Order in the form prescribed by the Board, advertise it in the local press and give notice to the Board and to each owner, lessee, and occupier of the land proposed to be acquired. Any objections to the Order must be sent to the Board within a month from the receipt of the notice. If no objections are received the Board will then confirm the Order forthwith, but if objections have been presented, the Board will give notice of a local inquiry, at which the Council and all persons interested in the land may appear and be heard. The Board, after considering the report of the person holding the inquiry, and the objections made, will then decide whether the Order should be confirmed or not, and with what modifications, if any. When confirmed, the Order becomes valid and has the effect of an Act of Parliament.

The Order having been confirmed, the amount of compensation to the various parties interested in the land remains to be settled. If no agreement can be arrived at as to the amount of compensation, the sum will be settled in the case of purchase by a single arbitrator, and in the case of hiring by a valuer, appointed in either case by the Board.

The possession of land which has been hired compulsorily may be resumed by the landlord on twelve months' notice if he can prove to the satisfaction of the Board that it is required to be used for building, mining, or other industrial purposes; and it is accordingly provided in the Act that the valuer in assessing the rent to be paid by a Council for land which is hired compulsorily shall not take into account any prospective value which might attach to the land if used for any purpose for which the landlord can resume possession. The effect of this provision is that land which has a prospective building value, but which is not yet ripe for that purpose, can in the meantime be hired by a Council at an agricultural rent.

Regulations as to the compulsory purchase and hiring of land, containing the prescribed forms for compulsory Orders, have been issued by the Board, and can be obtained either directly, or through any bookseller, from Wyman & Sons, Ltd., Fetter Lane, London, E.C., price 1*d.* per copy, or post free 1½*d.*

Adaptation and Equipment.

When land has been acquired by a Council they may adapt it for small holdings by dividing and fencing it, making roads, providing water supply, drainage, &c., and they may also, as part of the agreement for sale or letting, erect such houses and buildings, or make such adaptations of existing houses or buildings as are required for the due occupation of the holding and cannot be made by the purchaser or tenant. Not more than one house may be erected for occupation with any one holding.

Borrowing Powers of Councils.

A County Council or the Council of a County Borough may borrow money for the purposes of the Act from the Public Works Loan Commissioners, with the sanction of the Local Government Board, at a uniform rate of 3½ per cent., irrespective of the term of the loan. The Local Government Board will, as a general rule, be prepared to sanction the full term of 80 years allowed by the Act for loans for the purchase of land for small holdings. The maximum term for loans for the purchase of existing buildings, or for new buildings or other work of adaptation is 50 years, and the period allowed by the Local Government Board will vary according to the purpose of the loan. Fifty years will usually be allowed for existing or new buildings if their probable life is not less than that period, and a shorter period for other improvements according to their probable duration. On leasehold land, however, the term of the loan will not usually exceed the term of the lease.

Repayment of Preliminary Expenses of Acquiring Land.

Sec. 21 of the Act of 1908 authorises the Board, subject to regulations to be made with the approval of the Treasury, to pay out of the Small Holdings Account the whole or any part of the expenses incurred by a Council in proceedings in relation to the acquisition of land. Regulations under this section have been issued, by which the Board undertake to pay the whole of the expenses which have been necessarily or reasonably so incurred, and the Board have stated that though they cannot indicate precisely what particular items of expense will be subject to repayment, the following would seem to be the most important:—

(1.) Cost of report and valuation in respect of any land, the acquisition of which is under consideration by the Council (including cases where the land is not eventually acquired).

(2.) Cost of proceedings for obtaining a compulsory order.

(3.) Arbitration expenses in cases of compulsory purchase.

(4.) Valuation expenses in cases of compulsory hiring.

(5.) Conveyancing expenses.

(6.) Cost of registration of title.

If an officer of the Council is employed on any work connected with the acquisition of land for small holdings, it will be desirable that he should be paid for such work by fees or special allowance, in order to facilitate the adjustments of claims for repayment by the Board.

Losses under a Scheme.

By sec. 6 (4) of the Act of 1908, the Board are empowered to pay, with the sanction of the Treasury, the whole or part of any loss which may result from the carrying out of a scheme, and a Treasury Minute dated 31st December,

1907, has been issued, which authorises the payment of one-half of any irrecoverable loss which results from the working of a scheme initiated by the local authority and approved by the Board.

Sale or Letting of Small Holdings.

Land can either be let by a Council, or, in the case of land which has been purchased by agreement, it may, if the Council think fit, be sold on the terms referred to below. The rent or selling price of small holdings must be fixed at a sum sufficient to recoup to the Council the whole of their expenses in acquiring and adapting the land, except such expenses as are repayable by the Board. A sufficient sum should be added to cover tithe, land tax, repairs, management, and contingencies. Whether the sinking fund charges for the replacement of principal must be included in the rents of holdings is a question upon which opinions differ, and Councils are using their own discretion in the matter. As a general rule it will be desirable that rates and taxes should be paid by the tenants themselves.

Terms of Sale of Small Holdings.

Land which has been purchased by agreement may be sold by a Council on the following terms :—

(I.) At least one-fifth of the agreed purchase money must be paid down upon completion of the purchase.

(II.) A sum not exceeding one-fourth of the purchase money may, if the Council think fit, remain a perpetual charge upon the holding, *i.e.*, the purchaser will pay an annual sum representing the interest on that portion of the purchase money.

(III.) The balance of the purchase money, with interest, must be paid to the Council in half-yearly instalments spread over a period not exceeding 50 years. In certain cases the repayment of instalments may be postponed for five years.

Every small holding sold by a Council will remain subject to certain conditions for 20 years from the date of the sale, and thereafter so long as any part of the purchase money remains unpaid. The main object of the conditions is to ensure that the holding will not be diverted from the purpose of agriculture. Upon a breach of the conditions the Council may resume possession of the holding.

Power to Let to Associations.

With the consent of the Board a Council may let land for Small Holdings to associations formed for the purpose of creating or promoting the creation of small holdings, and so constituted that the division of profits among the members of the association is prohibited or restricted. The Board have drawn up rules which they will require to be adopted by every association desiring to rent land from a County Council for small holdings, and copies of these rules and other information as to the formation of associations may be

obtained from the Secretary of the Agricultural Organisation Society, Queen Anne's Chambers, Westminster, London, S.W.

There are obvious advantages from the point of view of the County Council in letting land to such associations or societies, who can undertake the whole responsibility of dividing the land, selecting the tenants, managing the holdings and collecting the rents, while the tenants will be in a very favourable position for the organisation of a system of co-operative purchase of their requirements and disposal of their produce.

Assistance to Co-operative Societies and Credit Banks.

County Councils are empowered by sec. 49 of the Act to encourage and assist credit banks and other co-operative societies which have as their object, or one of their objects, the provision or the profitable working of small holdings or allotments, and they may, with the sanction of the Local Government Board, give grants, and guarantee or make advances to such societies. They may also appoint a central co-operative society, such as the Agricultural Organisation Society, to be their agents for the purpose of promoting co-operation among the small holders in their county, and may make it the medium through which any financial assistance they propose to give should be dispensed to the local societies.

Assistance to Small Holding Tenants to buy their Holdings.

If the tenant of a small holding agrees with his landlord for the purchase of the holding, the County Council may, if they are satisfied that the title to the holding is good, that the sale is made in good faith and that the price is reasonable, advance to the tenant an amount not exceeding four-fifths of the purchase money. The holding then becomes subject to the same conditions as are imposed in the case of a small holding provided and sold by the Council, and the terms as to repayment of the advance are the same as in that case. The County Council should apply to the Local Government Board for permission to raise any loan that may be necessary for the purpose of making an advance. The maximum period for such a loan is fifty years.

Copies of the Small Holdings and Allotments Act, 1908, may be obtained, either directly or through any bookseller, from Wyman and Sons, Ltd., Fetter Lane, E.C., price *5d.* exclusive of postage.

Whitehall Place, London, S.W.,
September, 1908.
Revised, January, 1909.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 217.

BOARD OF AGRICULTURE AND FISHERIES.

The Provision of Allotments.

The Local Authorities who are responsible under the Small Holdings and Allotments Act, 1908, for the provision of Allotments in urban areas are the Borough or District Council, and in rural areas the Parish Council, or the Parish Meeting where there is no Parish Council.

The first step to be taken by Councils in regard to the administration of the Act is to institute an inquiry, either informally through individual members of the Council or by the publication of posters or advertisements in the local press, with a view to ascertaining whether there is any unsatisfied demand for allotments for the labouring population resident in their administrative area.

The Act empowers Councils to provide allotments up to 5 acres in size, but there is no obligation to provide allotments of more than one acre. If it is decided not to deal with applications between one acre and five acres, such applications should be sent to the County Council to be dealt with as applications for small holdings.

Allotments may be provided for persons of either sex belonging to the labouring population resident in the borough, district or parish.

The term "labouring population" is not defined and might be held to include only those persons whose main occupation involves manual labour. Tradesmen, licensed victuallers or employers of labour, or persons such as clerks whose main occupation is manual work but not manual labour, would be excluded by this construction, but in dealing with field gardens and similar small allotments, local authorities seem sometimes to have adopted a wider construction, and let the gardens or allotments to all persons of the working classes to whom they would be of real value. In the absence of any authoritative decision councils would seem justified in doing this.

Acquisition and Adaptation of Land.

When the applications have been received and have been examined to ensure that they are *bona fide*, the Council should proceed to ascertain from the local landowners whether they are prepared to sell or let land to the Council. If so, the Council should endeavour to come to terms with the landowners as to the price to be paid or the rent to be charged. Councils can acquire land for allotments outside their borough, district or parish.

Land may not be acquired for allotments except at such a price or rent as will, in the opinion of the Council, permit of

all expenses being recouped out of the rents to be obtained from the allotments. The rents to be charged for the allotments must, therefore, be sufficient to cover all the expenses to which the Council are put in acquiring and adapting the land, with a sufficient margin to allow for expenses of management and possible losses of rent. Councils are not, however, obliged to include in the rents as "expenses" the instalments of principal in repayment of a loan for the purchase of land, but may, if they wish, charge these instalments to the rates.

The land may be improved and adapted by draining, fencing, &c., and cottages and buildings may be erected or existing buildings adapted, but not more than one cottage may be erected for occupation with any one allotment, and no cottage may be erected for occupation with any allotment of less than one acre. Councils will be well advised to satisfy themselves before erecting cottages on small allotments that it will be possible to let them readily at sufficient rents to cover the cost of their erection.

Borrowing of Money.

If a Parish Council decide to purchase the land, they should obtain the consent of the Parish Meeting and apply to the County Council and to the Local Government Board for their sanction to the raising of a loan for the purpose.

Councils can borrow money in accordance with the provisions of the Local Government Act, 1894, for a period not exceeding 60 years, or from the Public Works Loan Commissioners, Old Jewry, London, E.C., for a period not exceeding 50 years, the latter being the better course as the Council would probably be able to get the money on more favourable terms. The rate of interest at present charged by the Commissioners is 3½ per cent. for loans for a period not exceeding 30 years and 3¾ per cent. for loans for a period between 30 and 50 years.

By Section 11 of the Local Government Act, 1894, Parish Councils are not permitted to raise for general expenses a sum exceeding the amount of a rate of *3d.* in the pound without the consent of the Parish Meeting, or of *6d.* in the pound if such consent is obtained, and the general expenses to which these limits apply include the amount of any annual charge, whether of principal or interest in respect of any loan. Any money borrowed by a Parish Council for the acquisition, improvement or adaptation of land for allotments is not, however, to be reckoned as part of the debt of the parish for the purpose of the limitation on borrowing under Section 12 of the Local Government Act, 1894, which restricts the total outstanding loans of a Parish Council to one half of the assessable value of the parish.

Letting to Co-operative Associations.

With the consent of the Board of Agriculture and Fisheries a Council may let land to co-operative associations formed for the purpose of creating or promoting the creation of allotments. The Board have drawn up rules which they will require every such land-renting association to adopt, and these rules and further particulars may be obtained from the Secretary of the Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, London, S.W.

Councils may make regulations dealing with the terms and conditions on which allotments will be let by the Council, subject to the confirmation of the Board of Agriculture and Fisheries, and draft model regulations have been prepared by the Board. Councils should accordingly consider the advisability of making such regulations, if they have not already done so, and should submit them to the Board for provisional sanction prior to steps being taken to advertise them in accordance with the provisions of Section 184 of the Public Health Act, 1875.

A register showing particulars of the tenancy, acreage and rent of every allotment, let or unlet, and separate accounts of receipts and expenditure with respect to allotments are required to be kept by a council.

Common Pasture and Grazing Rights.

Common pasture may, if the Council consider it desirable, be acquired by the submission to the County Council of a scheme for its provision, the County Council authorising the acquisition of the land in the same manner as if it were acquired for allotments. A sufficient charge must be made for the use of the common pasture to cover the cost of acquisition.

The Act also gives power to a Council to acquire land or grazing rights for the purpose of providing grazing rights to be attached to allotments provided by the Council.

Compulsory Acquisition of Land.

If suitable land cannot be acquired by agreement, a Parish Council may represent the case to the County Council who may, on behalf of the Parish Council, exercise powers of compulsory acquisition under an order which must be confirmed by the Board of Agriculture and Fisheries. If the County Council decline to make an order for the compulsory acquisition of land the Parish Council, if aggrieved at their refusal, may petition the Board. Borough and Urban District Councils are themselves empowered to acquire land compulsorily for allotments under an order made by the Council and confirmed by the Board of Agriculture and

Fisheries. No part of any holding of 50 acres or less can be compulsorily acquired. Regulations dealing with the compulsory purchase and hiring of land have been made by the Board.

Allotments set out under Inclosure Awards.

In many rural parishes there is land which was set out under Inclosure Awards to be let as field garden allotments. If such land has been transferred to the Borough, District or Parish Council under section 6 (4) of the Local Government Act, 1894, or section 33 of the Small Holdings and Allotments Act, 1908, the provisions of the last-named Act as to management, letting, application of rents, &c., apply to it, and the provisions of the Inclosure Act and Award are superseded. Such land may therefore now be let in holdings up to five acres each, or, if the land is inconveniently situated, it may be sold and the proceeds devoted to the acquisition of more suitable land elsewhere. By these means it should be possible to turn such land to greater advantage than has been possible hitherto.

Power of County Council to act in default.

If a Parish Council or the Council of an Urban District (not being a Borough) fails to fulfil its obligations under the Act it becomes the duty of the County Council to intervene. The County Council can then provide allotments up to one acre at the expense of the defaulting authority, and can deal with applications for over one acre of land as applications for small holdings.

The Board of Agriculture and Fisheries is the central authority under the Small Holdings and Allotments Act, except as regards questions of finance which are under the jurisdiction of the Local Government Board.

Copies of the Small Holdings and Allotments Act, 1908, may be purchased, either directly or through any bookseller, from Wyman & Sons, Ltd., Fetter Lane, E.C., price 2½*d.*, exclusive of postage. A Report of Proceedings under the Act is published annually in two parts, Part II. dealing with allotments.

Whitehall Place, London, S.W.
August, 1908.
Revised, June, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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Leaflet No. 218.

BOARD OF AGRICULTURE AND FISHERIES.

Associations for the Creation of Small Holdings.

The Small Holdings and Allotments Act, 1908, authorises local authorities, with the consent of the Board, to let small holdings and allotments to any association formed for the purpose of creating or promoting the creation of small holdings or allotments, and so constituted that the division of profits amongst the members of the association is prohibited or restricted (see sections 9 (2) (b) and 27 (6) of the Act).

With the view of facilitating the formation of such societies, and ensuring that they shall be watched over and helped with advice until firmly established, the Board have made a grant to the Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, S.W., on the condition that the money shall be applied to the furtherance of the agricultural co-operative movement as it affects small holdings.

The Society has now been reconstituted as a company limited by guarantee under the Companies (Consolidation) Act, 1908, for the purpose of administering a grant from the Development Fund for the extension of co-operative methods in agriculture. In accordance with the Articles of Association the Governing Body, which is to hold office until April, 1914, has been appointed by the Board and the Development Commissioners jointly. After April, 1914, the Governing Body is to be constituted as follows :—

(*a*) Eighteen Governors to be elected by the Members of the Society.

(*b*) Twelve Governors to be appointed by the Board.

(*c*) Two Governors to be appointed by the County Councils Association.

(*d*) Two Governors to be appointed by the Co-operative Union ; and

(*e*) Two Governors to be co-opted by the Governors.

The Agricultural Organisation Society has drawn up a set of model Rules which have been approved by the Board and by the Registrar of Friendly Societies, for adoption by any association or society desiring to hire land from a local authority under the Act. Copies of the model rules may be obtained on application to the Agricultural Organisation Society.

The advantages of letting land to an association need very little emphasising. The local authority will receive the rent in a lump sum from the association instead of having to

collect it from the individual tenants, and will be relieved of a good deal of responsibility in connection with the oversight and management of the land. The Committee of the association become responsible for the proper cultivation of the land and the punctual payment of rent by the tenants of the association, and as each member of the association is liable for a share in any loss that may be incurred there is the strongest possible incentive for the exercise of great care in the selection of the tenants. Moreover, where the members have co-operated for the acquisition of the land, they will be in a much better position to organise for co-operative effort in the purchase of requisites and the disposal of their produce.

Further, not only would it be possible for the local authority to let a whole farm to an association at a lower rent per acre than they would have to charge if they sub-divided it themselves and let to a number of individuals, but they could also work with a smaller percentage of margin to cover risks in respect of loss of rents; whilst on the other hand an association itself, formed on co-operative lines, with the knowledge that any excess of profits must accrue for the benefit of the tenants, when sub-letting land can fix, if necessary, a margin for contingencies which would be resented by the small holders as extortionate if demanded by the local authority.

This is exemplified in the case of the Kingsthorpe Small Holdings Society (*see* page 4) where the rents to the tenants, as originally fixed, averaged 6*s.* an acre above the average rent per acre of the farm as let to the society by the local authority. It was undoubtedly this ample margin which enabled the society successfully to surmount exceptional difficulties in the first year of its existence.

During the five years that the Small Holdings and Allotments Act has been in operation, over 7,000 acres of land in England and Wales have been let to 52 Co-operative Associations, and it may be useful to give a short account of a few of these Societies.

The Mere and District Small Holders' Society.—At Michaelmas, 1908, the Mere and District Small Holders' Society took possession of Burton Farm, Mere, on a 21 years' lease from the Wilts County Council. The farm comprises 431 acres and belongs to the Duchy of Cornwall. The Society consists of 36 members, 29 of whom are tenants of land on the farm, the size of the holdings varying from 1 to 30 acres. About 139 acres of the farm consist of down land which is let collectively; every tenant with over 3 acres of pasture land must hold one "leaze," *i.e.*, grazing for one head of stock. The land is found useful for turning out dry cattle and young stock. The Society pays the rates and

undertakes repairs, and the inclusive rent charged to the tenants of the holdings ranges from 22*s.* to 44*s.* per acre.

The Society has recently acquired from the County Council a further 260 acres, and has now obtained sufficient land to satisfy all its members.

The tenants all live in the neighbourhood and consequently there has been no difficulty as regards the provision of buildings. Milk production is the main business of the tenants and the milk is disposed of to two factories, at Mere and Gillingham. The stock on the farm at December, 1912, consisted of 180 cattle, 100 pigs and 14 horses as compared with 68 cattle, 80 pigs and 17 horses at Christmas 1908. A bull is kept by the Society for the use of its members. The number of men and boys formerly employed was 13. In addition to the 29 tenants there are now seven men and two lads employed.

The Biggleswade and District Small Holdings and Allotments Society.—Another instance of land being let to an association is that of the Stanford Farm, Southill, Beds. This farm, consisting of 368 acres (of which 307 acres are arable), was taken on lease by the County Council for twenty-one years from Michaelmas 1908. The Council sub-let 276 acres with the house and farm buildings to the Biggleswade and District Small Holdings and Allotments Society, comprising some 150 members. The land is sub-let by the Society in 35 holdings at rents ranging from 25*s.* to 45*s.* per acre. None of the tenants make their entire living from the land, most of them being market-garden labourers in the neighbourhood.

The Wayland Small Holdings Association, Ltd.—The Norfolk County Council took on lease for fourteen years from Michaelmas, 1908, the Wick Farm, Watton, comprising some 285 acres, and sub-let it to the Wayland Small Holdings Association, Ltd. The farm adjoins the town of Watton, which is 9 miles from Swaffham, 10 miles from Dereham and 21 miles from Norwich. At the commencement of the tenancy the land was in a very bad state of cultivation, but as the result of the first year's working great improvement was effected. The farm is let in 11 holdings and is cultivated as far as possible under the four-course system. Sixteen men are now regularly engaged as compared with six or seven formerly, and casual labour is also employed. With one exception the tenants make their main living from their holdings.

Though renting from an association the tenants do not at present adopt co-operative methods of trading, but they help one another to a certain extent in labour and in the exchange or hire of implements. A sum of one hundred pounds has been placed at their disposal at the local bank. This enables

the tenants to obtain small temporary loans upon the recommendation of the Committee. It has proved of great benefit to them and the loans are stated to be punctually repaid.

The Kingsthorpe and District Small Holdings and Allotments Society, Ltd.—The Town Council of Northampton acquired on lease for seven years from April, 1909, the Dallington Grange Farm, comprising 335 acres (arable 217 acres, pasture 115 acres, buildings 3 acres) which they let to the Kingsthorpe and District Small Holdings and Allotments Society, Limited, who in turn sub-let it in 16 small holdings and 70 allotments. The holdings vary in size from two acres to 55½ acres, and the average rent paid by the tenants is 37s. per acre. Six of the tenants live on the farm and five get their entire living from their holdings.

The report of the working of the Society for the year ending 30th June, 1910, stated that owing to the late entry on the land, its bad condition and the wet season, the tenants were at a great disadvantage, but with two exceptions they held on successfully. To enable the Society to carry out some alterations and pay part of the in-going valuation a loan of £235 for three years was obtained from the Central Agricultural Co-operative Bank.

The report on the third year's working to June 30th, 1912, showed that the financial position of the Society was quite satisfactory. The loan account had been reduced to £25, and the balance sheet showed a profit of £99 18s. 9d. The reserve fund stood at £100, and the Committee have recommended a reduction in the rents.

The Committee state that with very few exceptions the whole of the tenancies are being well cultivated and the general condition of the farm shows a steady improvement.

North Bromsgrove Market Gardeners, Ltd.—The members of this Society, which has hired land from the Worcestershire County Council, find that they effect a large saving in the cost of strawberry baskets (chips) by co-operative purchase. The members between them have some 600 tons of fruit and vegetables to dispose of annually, and they find that better prices can be obtained by bulking their produce and sending it to the Federated Growers, Ltd., at Birmingham for disposal, than by selling separately. This latter Society was specially formed, working on co-operative lines, to provide an outlet for the produce of Small Holding Societies, and to ensure for the growers the full market value of their fruit and vegetables.

The Society has also supplied Scotch-grown seed potatoes to its members to the value of £250, and saved a considerable sum of money to the purchasers in so doing.

The Society has instituted an interesting scheme of common pasturage. Two fields of meadow land, 8½ acres in all, have

been set aside for this purpose, and members are charged for grazing rights at the following fixed scale:—

	Horses.	Ponies.
May to Michaelmas ...	3*s.* 6*d.* per week.	2*s.* 6*d.* per week.
Michaelmas to March...	2*s.* 6*d.* „	2*s.* 0*d.* „

To encourage regular "customers" and to prevent, as far as possible, owners from taking the fresh spring "bite" and then withdrawing their animals, it has been decided that, in the event of an animal being kept in the grazing meadow from the time of opening until Michaelmas, 6*d.* per week shall be returned for the whole period in the case of a horse, and 3*d.* in the case of a pony. In winter, also, the same rebate is allowed off the winter prices, providing the animal is kept in as long as the weather allows.

Up to the present only horses have been taken in for grazing under this arrangement, and the result of the working during 1912 showed a profit of £2 3*s.* 6*d.* in favour of the Society.

The Epsom and Sutton District Small Holdings Society.—This Society entered into a lease with the Surrey County Council to rent part of the North Looe Farm, Ewell. Under the lease the Society are able to sub-let land in plots of from two acres at a rent varying from £2 5*s.* to £2 10*s.* an acre. The Council have erected a number of cottages, the rent of which is at the rate of 5½ per cent. of the cost. As an illustration, for a holding of two acres with a cottage costing £200, the rent is £16 per annum, or about 6*s.* 3*d.* per week, while that of a holding of five acres is £23 10*s.* per annum. Applicants for land through the Society had to satisfy the Committee that they were able to cultivate their holding properly, and that they possessed capital equal to £10 per acre.

Most of the instances given above illustrate the need of a wider application of co-operative methods, and it is greatly to be desired that associations that rent land should recognize, and take advantage of, the opportunities which their organisations offer for further effort in these directions.

Striking evidence as to the benefits derived from co-operative action has been received by the Agricultural Organisation Society. Amongst other examples given of such effort are the joint owning of horses and implements which are let out to members at a small charge, the purchase of coal, manures, seed-potatoes, &c., in bulk, the hiring of vans to convey members' fruit to market, and the holding of shows of vegetables, &c. Instances are also given in which land has only been obtained, or has been secured on more favourable terms, by reason of the applicants forming themselves into a Society.

The following statement gives particulars of all associations that had rented land for small holdings under the Act down to the end of 1912.

County.	Name of Association.	Quantity of Land Let.			Number of Tenants.
ENGLAND.		A.	r.	p.	
Bedford	Biggleswade and District Small Holdings and Allotments Society, Ltd.	368	2	17	35
	Stotfold Co-operative Small Holders, Ltd.	188	0	33	—
	Kempston Small Holdings Society, Ltd.	76	1	33	22
	Potton and District Small Holders, Ltd.	122	1	6	32
	Roxton Small Holdings Society, Ltd.	11	0	3	1
Berks	North Berks Small Holdings and Allotments Society.	588	1	13	45
Bucks	Cuddington Small Holders, Ltd.	82	2	29	14
	Ickford Small Holders, Ltd.	35	0	0	7
	Haddenham Small Holders, Ltd.	49	2	3	16
Cambridge ...	Gamlingay Small Holders, Ltd.	98	0	18	53
	Histon and Impington Small Holdings Association, Ltd.	42	0	8	18
	Over Small Holders, Ltd.	79	3	27	27
Dorset	East Stour Small Holdings, Ltd.	98	2	6	9
	Marnhull Small Holdings ...	101	1	38	9
	Sturminster Newton Small Holdings Association.	131	3	25	9
Durham	Ryton and District Small Holdings and Allotments Co-operative Society, Ltd.	230	3	25	79
	Ferryhill Village Small Holdings Society.	86	0	0	20
Herts	Bushey Co-operative Small Holdings and Allotments Association, Ltd.	25	3	9	7
	Watford Land Club League	42	1	0	—
	Croxley Green Small Holdings and Allotments Society.	35	3	22	11
	Sleaps Hyde Small Holders' Society.	32	1	16	6
	King's Langley and District Small Holdings Co-operative Society.	14	1	35	36
Leicester	Oadby Co-operative Small Holdings Association, Ltd.	52	1	31	—
Lincoln—Kesteven	Timberland and District Agricultural Union, Ltd.	116	1	26	10

County.	Name of Association.	Quantity of Land Let. A. r. p.	Number of Tenants.
Norfolk	Wayland Small Holdings Association.	284 0 27	11
Northants ...	Clipston and District Small Holdings and Allotments Society, Limited.	107 2 0	7
	Hargrave Small Holders' Society.	37 3 9	15
	Irchester Small Holdings and Allotments Association.	42 3 38	13
	Moulton and District Small Holdings and Allotments Society.	123 3 3	11
	Nether Heyford Small Holdings and Allotments Association.	141 0 0	26
	Rothwell Small Holdings and Allotments Society.	58 1 23	6
	Wollaston Small Holdings and Allotments Society.	299 3 0	18
	Flore and District Small Holdings and Allotments Society.	60 0 16	7
	Bozeat Small Holdings and Allotments Society.	102 0 29	32
Notts	Mansfield Woodhouse Co-operative Small-Holdings and Allotments Society, Ltd.	9 2 22	3
Somerset	Street and District Small Holdings Association.	207 2 7	—
	Radstock and District Small Holders' Society.	123 3 37	24
Southampton ...	Soberton Small Holdings and Allotments Association, Ltd.	43 2 36	11
Surrey	Epsom and Sutton District Small Holdings Society.	114 1 15	28
	Addlestone Co-operative Small Holdings and Allotments Society.	11 2 16	2
	Reigate Small Holders, Ltd.	194 1 30	7
Wilts	Mere and District Small Holders, Ltd.	688 0 0	28
	Gt. Somerford and District Co-operative Society, Ltd.	69 1 0	4
Worcester.. ...	East Worcestershire Small Holdings and Allotments Society, Ltd.	22 2 21	24
	North Bromsgrove Market Gardeners, Ltd.	46 2 10	60
Yorks, E.R. ...	Pocklington and District Small Holders' Society, Ltd.	29 3 26	7

County.	Name of Association.	Quantity of Land Let.			Number of Tenants.
		A.	r.	p.	
WALES.					
Glamorgan ...	Barry Small Holdings Tenants Association, Ltd.	184	0	0	12
	Birchgrove Small Holdings and Allotments Association.	543	0	0	18
	Cadoxton Small Holdings and Allotments Association.	102	0	0	10
County Boroughs.					
Newcastle upon Tyne.	Newcastle-upon-Tyne Small Holdings Society, Ltd.	88	3	0	28
Cardiff	Cardiff Land Holders Co-operative Association, Ltd.	259	1	0	18
Northampton ...	Kingsthorpe and District Small Holdings and Allotments Society, Ltd.	335	1	2	15

NOTE.—This leaflet does not apply to Scotland.

Whitehall Place, London, S.W.,
May, 1909.

Re-written, November, 1910.
Revised, July, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

Leaflet No. 219.

BOARD OF AGRICULTURE AND FISHERIES.

Glanders and Farcy.

Definition.

The names Glanders and Farcy relate to one and the same disease, which is caused by a microbe—*Bacillus mallei.* The term "Farcy," however, is usually applied to those cases in which the disease is located on the surface (skin) of the limbs or body, and the term "Glanders" is used to describe the disease when the principal symptoms are seen in the nostrils, glands under the jaw, and lungs.

Animals susceptible to the Disease.

Horses, asses, and mules are most commonly affected with Glanders. The dog, the cat, and the wild carnivorous animals may be infected.

The ox never contracts the disease, while for all practical purposes the sheep, goat, and pig are immune.

It is important to remember that man may also contract glanders from diseased horses.

Symptoms.

"*Hidden*" *Glanders.*—A horse may be affected with Glanders and show no particular symptom beyond a general unthriftiness, and is then often looked upon by those in the stable as "a bad doer." This form of the disease is spoken of as "occult" or "hidden" Glanders, and can only be diagnosed by the aid of the Mallein Test.

Occult Glanders in a stable is a serious matter. Animals so affected may at any time develop some slight discharge from one or both nostrils which is either continuous or appears at intervals. Such a slight discharge, especially if it only appears at intervals, is frequently not observed, or when seen is often not regarded with any suspicion until the animal "breaks up" and develops more advanced symptoms of the disease or dies from Glanders. During that time, however, the horse may have infected healthy horses and even man himself.

Not infrequently cases of occult glanders are discovered at the post-mortem examination of animals which have died from other causes, and were not suspected during life.

Typical Glanders.—In typical clinical cases of Glanders there is a thick grey-coloured discharge from one or both nostrils. Ulcers and ulcerous patches are to be seen inside

the nostrils, and the glands under the jaw are enlarged and hard, forming a lump which is commonly known as a "Jug." The temperature may be raised, but in chronic cases it may be no higher than the normal.

Acute Cases.—In severe and acute cases the temperature is several degrees above normal and the animal shows distinct symptoms of respiratory disease.

Farcy.—In Farcy one or more limbs become swollen. The lymph vessels stand out prominently on the inside of the limbs. They have a cord-like feel to the hand, and small nodules appear along the course of the vessels. These nodules frequently burst and become ulcers which discharge a thick yellow fluid of oily appearance. The ulcers may heal and leave a scar, but they usually break out again.

Farcy may also appear on the skin of the neck and body.

Post-Mortem Examination.

On post-mortem examination, in addition to the lesions already described, one may find ulceration of the throat and air passages, or, more commonly, small shot-like nodules are present in the lungs. They are formed by tissue products due to the action of the glanders microbes contained within them. The nodules vary in numbers from one or two to hundreds.

Virulent Material and Method of Spread.

The discharges from the air passages in the case of Glanders and from the sores in Farcy are very virulent because they contain the microbes which cause the disease.

Glanders is spread to a healthy horse either directly by contact with a diseased horse, or, indirectly, by such things as mangers, buckets, harness, grooming and stable utensils, sponges, contaminated food or water, and in fact anything upon which a glandered horse has left some virulent discharge.

Preventive Measures.

The spread of Glanders to healthy animals can be prevented by the removal and proper destruction of all diseased animals, and a thorough disinfection of all places and articles which are liable to have been contaminated by the virulent discharges.

The complete eradication of the disease from any premises is not, however, to be looked for unless the Mallein Test be applied to all animals showing suspicious symptoms, and to those animals which have been in contact with a diseased or suspected animal and which may therefore be affected with occult Glanders.

The application of the Mallein Test requires some skill and experience, but it is quite a reliable test for the detection of occult Glanders in the hands of a veterinary surgeon

A warning is desirable (especially to those who are brought into contact with horses) that a human being may contract Glanders from a diseased horse by inoculation through a wound or by rubbing a mucous membrane, such as that of the eye, with the soiled fingers, and that care should therefore be exercised in the handling of horses or the carcases of horses which may be affected with the disease, or suspected of being so affected, in order that this risk may be avoided.

In any case where handling is necessary the hands should be immediately afterwards washed with soap and water to which some suitable disinfectant has been added in the prescribed proportions.

Duties of Owners and others as to Notification of Glanders.

Under the Glanders and Farcy Order of 1907 made by the Board of Agriculture and Fisheries, it is the duty of every person having or having had in his possession or under his charge any diseased or suspected horse, ass or mule, to give immediate notice of the fact to a constable of the police force for the police area wherein the diseased or suspected horse, ass or mule is or was.

The duty also applies to every person licensed to slaughter horses in respect of a carcase of any diseased or suspected horse, ass or mule in his possession.

Under the Animals (Notification of Disease) Order of 1910, a veterinary surgeon or veterinary practitioner who in his private practice is employed to examine a horse, ass or mule, or the carcass of such animal, and is of opinion that the animal is diseased, or was diseased when it died or was slaughtered, or suspects the existence of disease therein, shall with all practicable speed give notice of the existence or suspected existence of disease to an Inspector of the Local Authority for the purposes of the Diseases of Animals Acts. A fee of 2*s.* 6*d.* is payable by the Local Authority for each notification.

Failure to comply with the requirements of these Orders renders a person liable to a fine of £20.

Whitehall Place, London, S.W.,
April, 1909.
Revised, December, 1910.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 220.

BOARD OF AGRICULTURE AND FISHERIES.

Agricultural Holdings Act, 1913.

The object of this Act, which received the Royal Assent on the 14th February, 1913, is to remove the doubts as to the effect of the Agricultural Holdings Act, 1908, in relation to market garden improvements, which were raised by the decision of the Court of Appeal in the case of *In re* Kedwell and Flint.

The effect of that decision was that a tenant from year to year under a contract of tenancy, current on the 1st January, 1896, of a holding which was at that date in use or cultivation as a market garden with the knowledge of the landlord, was not, in the absence of any written agreement that the premises should be let or treated as a market garden, entitled to compensation for improvements executed by him or his predecessors after the earliest day on which, if notice had been given immediately after the 1st January, 1896, the tenancy could have been determined.

The tenancy in that case was a tenancy from year to year determinable on the 11th October in any year by twelve months' notice, and accordingly the right to compensation for market garden improvements was limited to improvements executed before the 11th October, 1897. The effect of the new Act is to remove this limitation.

The terms of this enactment are as follows:—

" For removing doubts as to the effect of subsection (2) " of section forty-two of the Agricultural Holdings Act, 1908, " and any enactment which is re-enacted by that subsection, " it is hereby declared that a tenancy from year to year " under a contract of tenancy current on the first day of " January, eighteen hundred and ninety-six, shall not be " deemed to have been determined thereafter by virtue of " any provision contained in section sixty-one of the Agri- " cultural Holdings (England) Act, 1883, and the said sub- " section shall be repealed from the words 'Provided that' " to the end of the subsection."

The Act applies to any claim for compensation which has not before the 14th February, 1913, been determined by any judgment or order of a court of competent jurisdiction or award or agreement, whether the improvement to which the claim relates was made or begun before or after the commencement of the Agricultural Holdings Act, 1908.

Whitehall Place, London, S.W.,
March, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 221.

BOARD OF AGRICULTURE AND FISHERIES.

Mutual Insurance of Live Stock.

One of the oldest forms of co-operation in this country is the mutual insurance of live stock by means of what are known as cow and pig clubs. Complete returns as to their number are not available, but in 1905 the Board ascertained the existence of 1,021 pig clubs in England. Cow clubs are not so numerous as pig clubs, and they are believed to have decreased of late. Some of them, however, have been in existence for a great number of years. One in Shropshire was established in 1838, and had 518 members in 1907 and a reserve fund of £997, while another cow club in the same county dates from 1842, and with 296 members has accumulated a reserve fund of £1,440. The oldest registered society is one established near Ormskirk in Lancashire, which dates from 1807.

The extension in the provision of allotments and small holdings in England makes the establishment of societies of this type of great importance, and it is to be hoped that this simple and effective form of co-operation, which is well known and understood in the rural districts of England, will be largely adopted.

Method of establishing a Society.

Live stock insurance societies can be established by mutual agreement, and are not required by law to be registered or formally incorporated in any way, but the Friendly Societies Act, 1896, provides for the optional registration of societies, called in the Act "Cattle Insurance Societies," for the purpose of insurance to any amount against loss of neat cattle, sheep, lambs, swine, horses, and other animals by death from disease or otherwise.

The mere fact of registry affords no guarantee of the solvency of a society, but the rules which are necessary for the purpose of complying with the Act afford valuable help towards good management in various ways, and provide certain checks which are wholly wanting in respect of unregistered bodies.

It appears, however, that in England and Wales only 57 of these insurance societies were registered under the Friendly Societies Act on the 31st December, 1906. These had a membership of 4,819, or about 84 to each society. The receipts during the year amounted to £2,596 and the payments

to £2,150. The total assets at the end of the year were £8,434, or about £148 for each society.

Application for the registry of a cattle insurance society (including pigs, horses, &c.) must be made on a special form to be obtained from the Registrar of Friendly Societies, 28, Abingdon Street, London, S.W., and must be accompanied by two printed copies of the proposed rules. There is no fee for registration. The Registrar has prepared a set of model rules for the use of friendly societies, but these rules need to be suitably adapted to the circumstances of a cattle insurance society. A copy of the rules actually adopted by a society already registered could be obtained as an example, as registered societies are bound to supply copies to any person on demand on payment of a sum not exceeding one shilling.

Points to be considered in Drafting Rules.

Attention may be directed to the following points, which should receive careful consideration in drawing up the rules of a society, whether registered or unregistered.

Unlimited Liability.—In the case of registered societies the liability of each member for the engagements of the society is unlimited, and this might lead to serious difficulties if the society were to undertake the insurance of animals, such, for example, as valuable pedigree stock, to a greater amount than its funds would justify. In practice, however, such societies are understood only to undertake insurances for small amounts, and the risks incurred are, therefore, not great. It is desirable, however, that the rules should specify the maximum value which may be paid in any one case.

Area covered by the Society.—It is generally found desirable to limit the operations of the society to a comparatively small area, such as a few adjacent parishes. It is thus possible for all the members to know each other, while the cost of management can be reduced to a minimum. If, on the other hand, the members were to be distributed over any considerable area, the duties of inspection, valuing and marking might become somewhat onerous, and the necessary protection against fraud or intentional neglect, which is afforded by intimate acquaintanceship among the members, would be wanting.

One objection to the small area covered by a society is that in the event of great mortality, such as an epidemic of contagious disease, it may be unable to afford help when it is most needed. It might be desirable to provide for such a contingency by a rule to the effect that if the demands on the funds owing to an epidemic exceed the total amount of the funds in hand, the proportion of compensation payable may be reduced. Many clubs provide for a levy on all the members equally in the event of the funds being insufficient.

The objections connected with the limited sphere of operation could be removed by re-insurance, but although this is common on the Continent, it has not up to the present been practised in this country.

Compensation.—In the case of cow clubs, compensation is frequently paid at the rate of three-fourths of the full value, but in some the value is allowed up to, but not exceeding £10, with a lower limit for calves. In the case of pigs it is not uncommon to pay the full amount at which the pig is valued. On some grounds it would seem desirable that something less than the full value should be paid.

The valuation is usually made by a committee immediately on the illness of the animals being reported by the owner. On the Continent, however, animals are frequently valued on entry into the society, and this is, perhaps, the more reasonable procedure. It is also desirable from other points of view, as should the animal be attacked by a contagious disease, the visit of a valuing committee might lead to the spread of infection.

Compensation in the Event of Compulsory Slaughter.—In the event of the compulsory slaughter by order of the Board of Agriculture and Fisheries or of a local authority of any animals insured in the society, the compensation payable by the society would only be the difference, if any, between the sum for which the society was liable in case of death, and the amount actually paid by the Board of Agriculture and Fisheries or the local authority. It is, therefore, to the advantage of the club to insist that its members promptly report to the local police the suspected existence of any disease scheduled under the Diseases of Animals Acts. This should be provided for in the rules, and it might with advantage be laid down that no compensation should be paid for loss in the event of a member failing to report, as required by the order of the Board of Agriculture and Fisheries, the suspected existence of any such disease.

Employment of a Veterinary Surgeon.—Some clubs undertake to pay the fees of a veterinary surgeon called in to attend on sick animals, provided the necessary authority is first obtained from the committee of the society. It would probably be convenient to arrange with a veterinary surgeon to attend in such cases at a fixed fee.

***Precautions in Cases of Contagious Disease.*—When an animal is taken ill, it is usual for certain members of the society to inspect and value it, but should the disease be of a contagious nature there is a great risk that it may be unintentionally spread in this way. It is very important, therefore, that members thus employed should take the precaution of thoroughly disinfecting themselves upon leaving**

the cow-shed or pig-sty where the ailing animal is housed. They should wash their hands with soap and water, and their boots with a solution of carbolic acid or with some other suitable disinfectant. This is especially necessary in the case of pigs, owing to the possibility of the disease being swine-fever.

Should the existence of swine-fever be suspected, the owner must give notice of the fact with all practical speed to a police constable, in accordance with the provisions of the Swine-Fever Order of 1908. It is also of importance that before entering a sty for the purpose of carrying out their inspection the members of the committee should ascertain whether or not the provisions of Article 2 of that Order are already in operation, as to enter an infected place, in which a diseased or suspected pig is, or has recently been kept, would be an offence under the Diseases of Animals Act, 1894.

Method of Raising Funds.—There is commonly an entrance fee and a fixed annual subscription for each animal, in addition to a charge for inspection and marking on entry. This system has the advantage of simplicity, but it is open to the objection, particularly in the case of cows and horses, that the owner of a high-priced animal pays no more than the owner of one of less value, though in the event of loss he would receive considerably more from the society's funds. This objection could be removed by the valuation of each animal on entry into the society, and its annual re-valuation, with the adoption of a scale of premiums proportionate to the value. This system is frequently adopted on the Continent, and in the event of the accumulation of a large reserve fund the premiums are reduced. From the experience of a large number of societies in Bavaria, insuring in all over half-a-million animals, chiefly cattle, a premium of 1½ per cent. of the insured value, or 3*s.* for every £10, has, on the average, proved sufficient.

Reserve Funds.—The Friendly Societies Act requires registered societies to make provision in their rules for the investment of their funds, and it is desirable that the rules of unregistered societies should specify in the same way that funds not wanted for immediate use, or to meet the usual accruing liabilities, shall be invested by the trustees as the Committee may direct, in the Post Office Savings Bank, or in any savings bank certified under the Act of 1863, or with the Commissioners for the reduction of the National Debt, or upon Government or real securities in Great Britain or Ireland. The trustees or treasurers of registered societies may invest any sum of money, the property of the society, without restriction as to the amount, in any savings bank willing to receive their deposits.

The accumulation of a substantial reserve fund is undoubtedly desirable as a protection in the event of an epidemic of disease occurring in the neighbourhood, but it is very necessary that suitable provision should be made in the rules for the auditing of accounts, inspection of books, &c. In this connection it should be noted that the registration of a society ensures the proper keeping of the books, as a balance sheet, called the Annual Return, duly audited and signed by the secretary and treasurer, has to be sent each year to the Registrar.

In the case of fraud by its members the only criminal remedy open to an unregistered society is confined to cases of larceny or embezzlement, but a registered society has a remedy on summary conviction against any person who obtains possession of any of its property by false pretences or who withholds or misapplies it.

Cow Clubs.

The following description of an existing society may be taken as fairly typical of the method of conducting an ordinary cow club.

The society consists of officers and an unlimited number of members, the officers being the president, vice-president, secretary, treasurer, marker, and a valuing committee of three members. The duty of the president is "to keep order during meeting hours, impose fines and see justice done between each member and the society"; the marker brands each cow entered, the brand being placed on the horn, or, if the animal be hornless, on the right foot; and the function of the valuing committee is to determine the value in case of illness or death of a cow. The secretary receives a small salary for his work.

The society does not retain the services of any particular veterinary surgeon, and the members can employ whom they please. If a member's cow fall ill, the owner must report at once to the secretary, who forthwith advises the valuing committee, all of whom—or at least two of the three—go to see the cow as soon as possible. Directly the committee has appraised the cow and seen its condition it becomes the property of the society, and the committee can order its slaughter or can otherwise dispose of it. The full value of the cow as a healthy animal is fixed, and of this sum the owner receives 75 per cent., or 15*s.* in the £, the cheque on the society's banking account being drawn by the president, secretary and treasurer.

Any person wishing to become a member of the society must be proposed at a quarterly meeting. The entrance fee is 2*s.* 6*d.* for the first cow and 1*s.* for each subsequent cow. The subscription is 6*s.* per annum for each cow and is payable in monthly instalments; the cost of marking is 6*d.* per cow.

Hence, after the first year the cost of insuring three cows would be 18s., irrespective of the value of the cows. A member on entering a cow and describing its age and colour, pays the entrance fee and subscription, and forthwith becomes entitled to the benefits of the club. Promptness in payment of subscriptions is insisted upon under penalty of forfeiting all advantages.

The majority of the members have from one to two cows, while some have three or four and even six cows insured.

On the average about 3 per cent. of the insured cows die during the year, milk fever being the principal cause of death.

As a protection against the entry of old cows of little value, it is provided that no cow is to be accepted for insurance which has had more than two calves, while if the marker suspects any cow, which he is asked to mark, to be unsound or diseased, he is required to refer the matter to the valuing committee. The fact that the marker is a practical cowkeeper is found in practice to be a sufficient protection to the society. Where cows are lost owing to any contagious disease, the owner is not allowed to enter others on the books of the society until the cow shed and adjoining buildings have been thoroughly disinfected.

In some societies the full value of the cow is paid so long as it does not exceed £10, and the subscription is 1*s.* a quarter, with 1*s.* entrance fee. The subscription for calves is 9*d.* a quarter and 6*d.* entrance fee, the compensation payable varying from £2 to £5. The number of animals belonging to any one member is sometimes limited by rule so as not to exceed seven, of which two must be calves.

The value of these societies to small cowkeepers may be realized from the fact that individual members have, occasionally, received payment within a comparatively short time for as many as four cows. The secretary of one of the largest of these societies states that the members are in all cases small holders, and he observes that "among such holders the benefits of a society such as this are of the greatest—in fact, without some system of insurance small holders cannot exist, the loss of a cow being most serious to the man whose capital is but small."

Pig Clubs.

Pig clubs are conducted on somewhat similar lines, but they are usually composed almost entirely of cottagers and allotment holders. The number of pigs which may be insured by a single member is sometimes limited to three or four.

The entrance fee is frequently 1*s.* for each pig, sometimes 1*s.* in the £ on its value, and sometimes a fixed amount, such as 1*s.* 6*d.* per member. The subscription for each pig varies from 1*d.* or ½*d.* per week, 3*d.* a month, or 6*d.* a quarter. An

extra charge, usually about double, is made for insuring boar pigs or breeding sows, while sucking pigs are not admissible. The pig is marked on the ear, and the marker receives a few pence for his trouble. In case of illness the owner must inform the secretary, and a valuing committee then inspect and value the animal. The proportion of value allowed to the members varies; in some clubs it is 15*s.* in the £, in others 17*s.* 6*d.*, and in others the full value is paid. A few clubs pay less for high-priced pigs; thus 18*s.* is paid for a pig worth £1; £1 15*s.* 9*d.* for a pig worth £2 and a smaller proportion for each additional £. The committee may, if they wish, dispose of the pig on behalf of the club.

The reserve funds naturally vary very greatly. Many clubs have funds up to £100–£150, but £20 to £30 is often considered a sufficient reserve fund for clubs with 40 or 50 members, and occasionally further profits are divided up annually after the manner of dividing clubs. Although the societies are formed for and rely entirely on mutual help, their income is frequently augmented to a small extent by subscriptions from honorary members.

NOTE.—Information as to the insurance of live stock in Holland, Belgium, France, Switzerland, Germany and Sweden was given in the *Journal of the Board of Agriculture*, April, 1908, p. 32, and as to insurance in Denmark and Norway in October, 1908, p. 523.

Whitehall Place, London, S.W.,
September, 1909.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 222.

BOARD OF AGRICULTURE AND FISHERIES.

Meadow Saffron (*Colchicum autumnale*, L.)

Meadow saffron is a plant belonging to the order *Liliaceae*, with a flower closely resembling that of the crocus. The leaves are lanceolate in shape, dark green in colour, and several inches in length; they are fully developed in spring, dying down during the summer. The flowers are whitish or pale purple in colour, and may be found locally in meadows from the far north of England to the South Coast. The plant is said especially to occur on limestone. Meadow saffron grows from corms (or bulb-like fleshy under-ground stems) about the size of small tulip bulbs. These lie about 6 to 10 in. beneath the surface of the soil. Flowering takes place from August to October, but the blooms soon die down, and the seed vessel remains beneath the surface of the ground until the next spring, when it is sent above ground with the leaves, and the seeds then ripen. Thus the leaves and seed capsules (which may contain 100 seeds) may be found in hay, but not the flowers.

Poisonous Nature of the Plant.

Meadow saffron—known also as autumn crocus, meadow crocus, naked ladies, &c.—is poisonous in all its parts. According to Cornevin it has caused numerous cases of poisoning among horses, cattle and pigs. In April and May this may be due to the consumption of the leaves and seed vessels, while from August to October it may be caused by the flowers. "As the plant is injurious to most animals and man, it should be destroyed in fields, for cattle will sometimes crop the leaves in the spring" [*English Botany*, Vol. ix.] Percival writes: "Experiment has shown that from 3 to 5 lb. of green leaves and seed vessels are necessary to act fatally upon a cow; the poison, however, appears to be cumulative and a small quantity eaten each day with other food for a few days may lead to fatal results." The poisonous principle, known as *Colchicine*, is not volatile, and, contrary to common belief, is not removed by drying the plants, and hence hay which contains the dried foliage may lead to fatal results. The poison causes burning in the throat, considerable flow of saliva, with violent purging, and may end in syncope.

Remedial Measures.

1.—Where meadows are infested with *C. autumnale* in very small numbers the corms may be dug out by hand, and the whole plant burnt. Where, however, the plant occurs in extensive patches the best method is to pull off all leaves by hand as fast as they appear in spring and burn them. It has been stated that if this practice is repeated for one or two seasons there is no necessity to dig up the corms, the plant being readily exterminated.

2.—Cutting or pulling should again be resorted to from August to October when the flowers appear.

3.—Bornemann mentions as having given good results in Germany a short three-pronged iron moving on a hinge and fixed at the end of a long iron resembling a crow-bar with the lower part somewhat flattened. On the tool being driven into the ground the prongs close in an upward direction, allowing easy passage downwards, but on turning the implement round so that the prongs are underneath the corm and pulling up, the prongs automatically open and grasp the corm from below, thus removing it.

4.—The effects of heavy dressings of such soluble manures as superphosphate, sulphate of ammonia, and kainit might be tried, both alone and in combination.

It is probable that repeated and thorough destruction of the flowers and leaves will suffice to eradicate the plant in three years. Stock should not be allowed access to a field containing Meadow Saffron when either leaves or flowers are visible.

Description of Plate.—1. and 2. Anthers; 3. Pistil. The other three figures show a plant in bloom as it characteristically appears in the field, leaves and seed vessel as they appear in spring, and the corm.

Whitehall Place, London, S.W.,
August, 1909.
Revised, August, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

MEADOW SAFFRON (*Colchicum autumnale*, L.).

Leaflet No. 223.

BOARD OF AGRICULTURE AND FISHERIES.

The Brown Scale of the Gooseberry and Currant

(*Lecanium persicae*, var. *ribis* Fitch).

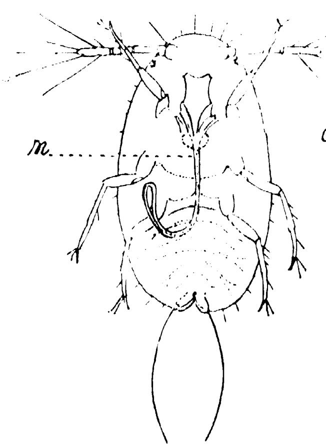


Fig. 1.—Larva magnified about 50 diameters (*m*), mouthparts.

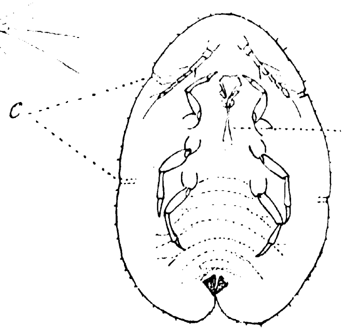


Fig. 2.—Underside of young female magnified about 15 diameters. (*c*). channels leading to respiratory tubes (stigmata). (*m*), mouthparts.

This insect is found in great abundance on the gooseberry, currant, rose, plum and cotoneaster, but rarely on raspberry; and it has also been found on a variety of other cultivated and wild plants.

It has a decided preference for the older branches, the young shoots being attacked only when the insects become overcrowded.

It is as a rule much more prolific on plants grown in sheltered spots, especially on well-trained trees in a fairly sunny aspect, and no plant suffers in such situations so much as the cotoneaster.

It is very generally distributed throughout England, but is less known in Wales, Scotland, and Ireland.

There can be no doubt that this insect is a variety of the peach scale (*L. persicae*), differing only by its usually smaller size, its more rotund or hemispherical form, and the more marked character of the blackish, transverse bands in the immature stage. Apart from these exceptions the description of the one serves equally for the other, and the methods of control herein described will serve equally well for both kinds.

Description.

Female.—The young gravid female (Fig. 2) is short and ovate in form, being a little longer than it is broad, flat beneath and highly convex above. The colour of its upper parts varies from dusky ochreous-yellow to greenish yellow, with eight or nine more or less interrupted, blackish, transverse bands, of which the foremost is the broadest, the rest diminishing in width as they approach the hinder or cleft extremity of the body. The legs and antennæ are retained, but the insect loses all power of locomotion long before the period of egg-laying commences. As the insect matures the pale colour gradually changes to bright chestnut brown or ochreous brown. At this stage the integument becomes hard and brittle and bears a number of transverse wrinkles at the sides.

Larvæ.—The young larvæ (Fig. 1) are quite minute, about the size of a large cheese mite, which they somewhat resemble, except that they possess but three pairs of legs, have rather long antennæ, and two long bristles at the end of the abdomen. They are active for a short time, but soon become inert. The mouth parts (Fig. 1 *m*) consist of a fleshy lip or labium through which pass the extremely slender hair-like mandibles and maxillæ with which the insect pierces the bark and through which it sucks up the juices of the plant—collectively therefore these organs form a sucking tube.

Male.—The male of this insect has not yet been discovered, and there can be no doubt that the females are able to reproduce their species without the intervention of the opposite sex. This remarkable trait is, however, quite common among scale insects and some of the plant lice (*see* Leaflet No. 104).

Life History.

The female begins to lay her eggs while the body is yet soft and distended; and as the process develops the ventral surface of the insect shrinks until it finally reaches the under surface of the outer hardened skin, so that a relatively large cavity is formed beneath the insect which is filled with hundreds of whitish translucent eggs. At this stage the insect dies and her dead body, the so-called "scale," forms a protection for the eggs, and for a short period also for the young larvæ or "lice." The young escape from beneath the dead parent chiefly through the little slit or cleft at the posterior extremity, leaving behind them the white egg shells and a little white mealy secretion.

The larvæ usually fix themselves under the partly detached or curled up portions of the bark so that they are often completely hidden, and in this way pass the winter without any material change. They are then of a reddish brown colour and so small that at first sight they may be easily

mistaken for the stomata of the plant. In spring they cast their skins, and may become active for a short period; in June they become adults and the cycle commences again. The old "scales" or dead females may, if undisturbed, remain attached to the host plant for a very long period—two or three years in some instances; it often happens therefore, that the representatives of two or three generations may occur on the plant at the same time.

The scale insects indigenous to this country are probably single brooded, but egg-laying may sometimes be retarded by the influence of the weather, while the young larvæ may continue to hatch out for a relatively long period, so that the life cycles are not always clearly defined and there may be a slight overlapping of the stages of development.

Remedies and Methods of Control.

This scale can be best controlled by winter and by spring washing. It should be borne in mind that it is the larvæ or young insects which are found living during the winter months; and as they are very minute and often protected by the semi-detached bark, the spraying must be thorough or the result will not be satisfactory. Care must also be taken to ensure that the under sides of the branches are well sprayed, as the insects are usually more abundant in such situations than on the exposed and more accessible portions of the bushes.

It is advisable to complete pruning before spraying operations are commenced; and in the case of old and badly infested plants it is desirable to remove as much of the old wood as is practicable.

The spraying apparatus should have the nozzle fitted at an angle of about 45 degrees so that the spray may be conveniently directed to the under sides of the branches.

In the case of the gooseberry, "sponging" or "brushing" is practically impossible owing to the spinose character of the branches.

(1) The best winter wash is *Caustic Soda Wash.**—This wash consists of :—

Sulphate of iron	½ lb.
Lime...	¼ "
Caustic soda...	2 "
Paraffin	5 pints.
Water to make 10 gallons.	

The wash should be prepared as follows:—(*a*) Dissolve the iron sulphate in about 9 gallons of water. (*b*) Shake the lime in a little water and then add a little more water to make it into a "milk." (*c*) Run "*b*" into "*a*" through a piece of coarse sacking to keep back grit. (*d*) Churn the paraffin

* *See* Leaflet No. 70. This is the spray known as the "Woburn Wash." *See* Report for 1906 of the Woburn Experimental Fruit Farm.

into the mixture. (*e*) Add the caustic soda in the powdered condition. It is not wise to add the caustic soda till just before using.

Rubber gloves should be worn by the sprayer as a protection against the effects of the caustic soda, and goggles fitted with a piece of rubber sheeting or waterproof of some kind are an excellent safeguard for the eyes and face.

(2) For spring washing Theobald recommends paraffin jelly made by boiling together 5 gallons of paraffin and 8 lb. of soft soap, a pint of cold water being added during boiling. After stirring, the material is allowed to stand and when cold it forms a jelly. For spraying 10 lb. of the jelly may be used in 40 gallons of water.

Whitehall Place, London, S.W.,
May, 1909.
Revised, February 1912.

Leaflet No. 224.

BOARD OF AGRICULTURE AND FISHERIES.

Narcissus Cultivation.

Until twelve or fifteen years ago the Dutch had almost a monopoly of the bulb trade of this country, but bulb cultivation has recently been successfully undertaken in various parts of the British Isles. Bulb culture is one of the chief industries in the Channel Islands, and during the spring months tons of bloom are thence daily despatched to London and other large centres, to be followed in the summer by the further despatch of tons of bulbs. In the South Lincoln and Cambridgeshire Fens many acres of bulbs are now planted, several of the larger growers having from twenty to fifty acres under cultivation. An ideal bulb soil is found there, which, with good culture, produces bulbs equal to those grown in Holland, and, in addition to supplying a home demand, a considerable export trade is now being conducted from this centre. It is probable, however, that there are many other parts of England where the soil and climate would also be found suitable, and as narcissus cultivation is an industry which can be begun on a small scale, it is one which appears to be well worth the attention of small holders and others.

This leaflet is intended to give an indication of the elementary principles of narcissus culture, and deals first with the growth of bulbs for sale as bulbs, and secondly as blooms.

I.—GROWING BULBS FOR SALE.

Suitable Soils.

The soil best suited for narcissus cultivation is a deep, friable loam. Stagnant moisture is detrimental to the plants, and where such a condition exists it must be remedied by draining and raising the beds above the level of the paths.

Preparation of the Soil.

Land from which an early crop of potatoes has been lifted furnishes a very suitable soil for narcissi. When preparing it for the potato crop, the land ought to receive a heavy dressing of farm yard manure, from forty to fifty tons per acre, according to the condition of the soil. As soon as the potatoes are cleared off, at the end of July or beginning of August, the land should be deeply ploughed or dug so that the enriched top spit is placed in a position to allow the roots of the narcissi to penetrate freely. If the soil is in-

fested with weeds such as twitch, bindweed, thistles, docks, &c., these should be removed as the work proceeds, as it is impossible to eradicate such pests once the bulbs are planted. If the work has been done by the plough the ground should be broken up by harrowing and rolling, but if dug by the spade it should be broken up as digging proceeds. This accomplished, and a good tilth obtained, the land is then ready for planting. The soil should be uniformly level, as hollows in which water stands injuriously affect the bulbs.

Manures.

Fresh farm-yard manure must never be used for narcissus cultivation; its ammoniacal constituents have an injurious effect upon the plants, and this is the chief reason for recommending that they should follow such a crop as potatoes where the rankness of a heavy manuring has already expended itself. Fifty tons of farmyard manure per acre may appear to be an unnecessarily large amount, but, unless the ground is in good condition, it is not an excessive quantity. Good bulbs, like most other crops, cannot be grown on poor land. If it be necessary to plant on land which has not recently been well manured, bone-meal is probably the best artificial manure to use at the time of planting: it should be applied at the rate of ten to fifteen cwt. per acre, and can either be harrowed or raked in before planting commences, or worked in as planting proceeds.

Time of Planting.

As a general rule, the shorter the period the bulbs are out of the ground the better. In some cases, such as in the *Poeticus* section, new roots are formed simultaneously with the decay of the old, and a decided injury is done by keeping such varieties out of the ground for a lengthened period. With few exceptions, however, narcissi may be planted as late as Christmas, and still give fair results; but the best time for general planting is during August and September, and all planting should certainly be finished during October. The ground should be dry and friable at the time of planting.

Methods of Planting.

Planting should be done at a depth of three to six inches—the larger bulbs at the greater depth, and the smaller ones proportionately shallower. Various methods of planting are adopted, and the area to be planted will influence the method decided upon. Many large growers use a one-horse plough, to which is fixed a special share that works in the bottom of the furrow and makes the necessary impression for the reception of the bulbs; and on large establishments the work

is expeditiously performed in this way. From eighteen to twenty-four planters are necessary to keep the plough constantly at work, and an acre a day may be planted. The cost would be :—Man and horse per day, 8*s.* ; twenty-four planters at 2*s.*, £2 8*s.*; man in charge, 4*s.*; total, £3 per acre.

This method is suitable where any variety of bulb is being planted in large quantities. The work proceeds in the ordinary way of ploughing, one furrow covering the bulbs already planted in the furrow previously made. The furrows are about nine or ten inches wide, and every seventh furrow is left unplanted, and this forms a path, which is necessary for getting among the bulbs when bloom-gathering, cleaning, &c.

Where small areas are planted, a different method must be adopted. The following is a useful plan :—First divide the land into suitable divisions, say fifty feet wide, with eighteen-inch paths between. Then stretch a line across the end of the first division, and with a spade throw out a shallow opening in which to plant the first row of bulbs. This done, shift the line the width of the rows, say nine inches; then proceed to open the second furrow, covering the first and already planted row with the soil from the second. Proceed thus with succeeding rows, again leaving every seventh unplanted to form a path. By this method one man with a spade will keep two planters busy, and the cost will be about £4 per acre.

Another method for the small grower, after he has marked his land into fifty-foot divisions with eighteen-inch paths, is to mark each division across with beds 3 feet 6 inches wide and with paths 12 inches wide. The soil from the first bed is taken out to a depth of 3 inches and wheeled to the far end of the division; this first bed is then carefully raked, and marked across in rows 6 inches apart. The bulbs are then planted, and this bed is covered with soil taken from the second bed, and so the work proceeds to the end of the division. This method, although a little more expensive than the preceding, has advantages, especially where handling a considerable number of varieties in small quantities, as the danger of mixing sorts is less likely to arise.

The quantity of bulbs necessary to plant a given area will vary considerably, according to the size of bulb produced by the particular variety. From 4 to 5 tons may be taken as an average weight to plant an acre.

Cultivation between Planting and Harvesting.

The chief labour involved is in keeping the ground clean, and this necessarily varies according to the condition of the land and the weather. When planting has been done early, say in August or September, weeds will soon begin to show. These can be kept in check by hoeing

(large growers use horse labour), provided the weather is favourable. If it is showery, so that hoeing is not effective, the land must be lightly "pointed," *i.e.*, shallow-dug, in order to bury the weeds. For this work a broad-tined fork is the best tool to use, and the most suitable time to perform the operation is at the end of October or beginning of November. If performed earlier there is the risk of another crop of weeds appearing; if done later, the bulbs may be too far advanced, and damage may result in consequence. Large growers use the plough for this work.

During the winter months some growers protect their bulbs from frost by covering the ground with heather or other loose litter, but for the varieties to be recommended this labour is unnecessary. In February, before the foliage pushes through the ground, soot may be applied broadcast and lightly harrowed or raked in. This is especially recommended where bulbs have remained in the same position two or three years.

During the spring months weeds must be kept in check by hoeing and hand-weeding, care being taken that the least possible damage is done to the foliage. Treading on the beds is to be avoided as much as possible. When the foliage dies down, the whole area should be hoed over if the bulbs are to remain another year, and the operation should be repeated two or three times during the summer months, which is all the attention necessary until the period for autumn "pointing" again returns.

Harvesting.

As soon as the foliage has died down, a start must be made to raise those bulbs which it is desirable to lift. No time must be lost in this work, as in the event of showery weather fresh roots will very soon be produced, and the aim of the grower is to get his bulbs out of the ground whilst root-growth is dormant.

Many large growers use the plough for lifting as well as planting. By its use a careful and experienced ploughman and a sufficient number of pickers can lift large areas very expeditiously at a lower cost than where forks are used, while less damage is done and fewer bulbs are left in the ground. The small grower, however, must resort to the fork. The bulbs as lifted should be put in shallow trays or baskets, and, if possible, be placed in a cool, airy shed to dry. If such shelter cannot be given them, they may be allowed to lie on the ground until they become dry and clean. They must not, however, be allowed to remain too long, in case they get scorched by strong sunshine. The length of time necessary depends upon the condition of the bulbs when lifted and the weather experienced, but once they are in a fit condition no time should be lost in getting them under cover, as if showery weather sets in

root-growth will very quickly commence, and this should be prevented. All lifting should be finished by the end of July at the latest.

The weight of produce lifted must necessarily depend upon the fertility of the soil, the variety grown, and the length of time the crop has been planted, but eight to ten tons per acre may be regarded as an average yield, or about double the weight planted.

Preparation for Market.

Various methods of marketing are employed. Bulbs may be sold as lifted, large and small together, by the cwt. or ton, and many people (especially planters) prefer to buy their bulbs in this way. Retailers, however, and wholesale dealers who supply retailers, require first- or second-size shapely bulbs only. It then becomes necessary to clean and size the produce, making four different sizes, viz., first or "heads"; seconds; thirds or "planting" size; and "chips." First-size bulbs of the popular varieties can be readily sold to bulb merchants by the 1,000, and the other sizes should be kept for planting purposes.

In growing for bulb production a more frequent course of transplanting is necessary than when bloom is the chief object, and nice, shapely bulbs, such as are wanted for shop sales, can only be obtained by regularly transplanting. When first-size bulbs are planted they multiply and give increased stock, and it is well to let such remain two or even three years undisturbed. Second-size bulbs, if carefully sized, should yield "heads" (or firsts) after one year's growth. Thirds and "chips" require two years before attaining saleable size, and then half only may be fit to be classed as "heads."

This sizing requires the exercise of some discretion, as by its careful performance much unnecessary labour may be saved. Thus the grower who sizes and plants what he hopes to lift as first-size bulbs after one year's growth incurs needless labour and expense if only fifty per cent. of the produce attains first size. A little experience, however, will suffice, and the cultivator will be able to estimate from the bulbs planted approximately what quantity of different sized produce he will have for disposal each year.

Varieties to Cultivate.

The following varieties may be recommended for the production of outside bloom and some of them for forcing under glass. The prices given afford some indication of the average value of the different kinds, but they will naturally vary according to season and other circumstances. The demand which has arisen in recent years for flowers for house decoration has created quite a large industry in

bulb forcing, and as the demand for varieties suited for this purpose is greater than for the numerous varieties grown by the bulb specialist, these are more likely to prove remunerative to the small grower. When growing for bulb production the bloom is also marketed in spring, so that profits both from bloom and bulbs are obtained.

1st. *Golden Spur.*—A deep rich yellow trumpet. It is the first to bloom of those recommended in this leaflet, and is a variety extensively grown for forcing. Wholesale price for first-size bulbs varies from 35*s.* to 40*s.* per 1,000. All sizes as lifted from £30 to £40 per ton.

2nd. *Incomparabilis Sir Watkin.*—A large handsome flower with primrose perianth and yellow cup. A strong grower and a good forcer. Wholesale price for first-size bulbs from 30*s.* to 35*s.* per 1,000. All sizes as lifted from £20 to £25 per ton.

3rd. *Emperor.*—A large flower having a deep primrose perianth and yellow trumpet. It is a very strong grower. Wholesale price for first-size bulbs from 30*s.* to 35*s.* per 1,000. All sizes as lifted from £15 to £20 per ton.

4th. *Bicolor Horsefieldii.*—A free flowering variety with white perianth and yellow trumpet. Wholesale price for first-size bulbs from 20*s.* to 25*s.* per 1,000. All sizes as lifted from £12 to £15 per ton.

5th. *Bicolor Empress.*—This is a very similar variety to the preceding one, but flowers about a week later. Wholesale price for first-size bulbs, 30*s.* to 35*s.* per 1,000. All sizes as lifted, £15 to £20 per ton.

6th. *Barri Conspicuus.*—A flower with a broad yellow perianth and yellow cup edged with orange-scarlet. This variety is much admired, but unfortunately it is apt to lose its colour in bright sunshine. To obviate this it is well to plant it in partial shade. Wholesale price for first-size bulbs, 12*s.* to 16*s.* per 1,000. All sizes as lifted, £6 to £8 per ton.

7th. *Poeticus Ornatus.*—This white narcissus is probably the most profitable variety that anyone can handle, and it is grown in large quantities for cut flowers both in the open and under glass. It blooms very freely, and, being a small bulb, can be planted closely, thus giving a much larger yield per acre than any other variety. Wholesale price for first-size bulbs, 10*s.* to 15*s.* per 1,000. All sizes as lifted, £20 to £25 per ton.

8th. *Bicolor Grandee.*—This is a late trumpet narcissus which flowers after the majority of the others, and usually sells well as a cut flower. Wholesale price for first-size bulbs, 12*s.* to 15*s.* per 1,000. All sizes as lifted, £6 to £8 per ton.

9th. *Pheasant Eye.*—This is grown chiefly for cut-flower purposes; like the preceding, it flowers when the majority

of narcissi are past, and in some years yields the grower a good profit. Wholesale price for first-size bulbs, 5*s.* to 7*s.* 6*d.* per 1,000. All sizes as lifted, £4 to £6 per ton.

10th. *Poeticus plenus or Double White.*—This is the last of all the narcissi to flower. It blooms towards the end of May, and usually realises good prices. It likes a rather heavier soil than the majority of narcissi, does best when deeply planted, say from 6 to 8 inches, and may remain three to four years without transplanting. Wholesale price for first-size bulbs, 10*s.* to 12*s.* 6*d.* per 1,000. All sizes as lifted, £10 to £12 per ton.

Cost of Cultivation.

As the annual rental and cost of labour differ considerably in different localities, it is impossible to give an estimate suited to all conditions. The following represents as nearly as possible Fenland expenses per acre, which in some details are probably lower than those incurred in other parts of the country :—

	£	*s.*	*d.*
Annual rent, rates, and taxes	6	0	0
Manure, 40 tons at 7*s.* 6*d.*	15	0	0
Bulbs for planting, 5 tons at £15	75	0	0
Preparation of land (digging 1½ spits) ...	4	0	0
Planting	4	0	0
Cleaning of ground (1 year)	5	0	0
Lifting bulbs	8	0	0
Cleaning and sizing bulbs	2	0	0
	£119	0	0

If horse-labour is employed, the cost for preparation of the land will be considerably lessened. If ploughed with three horses, or a two-horse plough and sub-soiler, the work would cost £1 instead of £4, whilst the cost of lifting is also considerably lessened, and can be done for £5 instead of £8 if women and boys are available for picking up. Again, the cost of bulbs for planting must vary considerably, according to the varieties planted. The cost of planting an acre with Pheasant Eye at £5 per ton would differ considerably from planting the same area with Emperor, Sir Watkin, or other more expensive varieties at £20 per ton. Rent, rates and taxes, too, will not always amount to £6 per acre.

The planter is strongly recommended when purchasing to buy either "planting size" or bulbs as lifted at so much per ton, instead of securing first-size bulbs. As previously stated, the latter, when planted, will yield "stock,"—that is

they split up and increase in quantity, and this necessitates waiting for three or even four years before a profitable crop of first-size bulbs can again be secured. If bulbs are purchased "as lifted," and divided into four sizes, as already described, all of them can be planted. The second-size bulbs will produce "heads" the first year, the third size and "chips" will yield a large percentage of "heads" the following year, whilst the third season, by lifting those planted as "heads" three years previously, a large yield of planting stock will be secured. This gives a much quicker return on capital than is possible when first-size bulbs only are planted, and the initial outlay is also less.

Value of Produce.

This will vary according to the varieties grown, the quantity and quality of bulbs planted, the length of time they have been allowed to remain in the ground, and, lastly, the suitability of the land for bulb culture. As the several varieties differ so much in value, the best method of arriving at an estimate will be by percentage increase on cost of "seed" bulbs. Bulbs planted one year will increase from 30 to 50 per cent. in value; those planted two years from 75 to 100 per cent. In addition, there is the cut bloom which must be taken into consideration, and this may be expected to add from £15 to £20 per acre to the returns.

II.—Cultivation for Bloom.

The chief difference in cultivation when growing for cut flowers is that less frequent lifting and replanting is necessary. The bulbs may remain two or three years—some few varieties even longer—and increase their yield annually. As a rule, however, after remaining three years, a shift is desirable, as the bulbs then become crowded and too small to bloom satisfactorily, while the land also becomes exhausted. The labour required for keeping the land free from weeds is the same as when growing for bulbs, but the annual cost of lifting, cleaning, sizing, and replanting is saved.

Marketing the Bloom.

Gathering and Bunching.—As the blooms expand they must be gathered and marketed whilst fresh. An effort should be made to have the bloom fit for market earlier than would be the case if left to take its natural course. This can be accomplished by pulling the flowers when in the bud state and opening them in water under glass, or by erecting a temporary covering of glass over the growing plants. The grower without glass is at a great disadvantage, and glass is absolutely necessary to obtain the best results, as without a greenhouse the grower is at the mercy of the elements at a time when much rough and stormy weather is frequently experienced. The cultivator with glass at his disposal can

gather the flowers in the bud state, open them in water, and thus ensure all his bloom reaching the market clean and in good condition.

To avoid glutted markets, it is sometimes desirable to prolong the bloom for a few days; this is done by placing the buds in water in a cool, shaded shed. The best receptacles in which to place the blooms are narrow troughs or boxes divided into several sections each about four inches wide.

In the Fen district the work of gathering and bunching is generally done by women and boys. The gathering should be done by boys whenever possible, as the women's skirts cause considerable damage among the growing blooms. As the bloom is gathered it is placed upright in boxes or baskets, then taken to the bunching room, where it is tied into bunches of twelve blooms each by the women workers. The aim of the buncher is to have all the blooms facing one way without presenting a crowded appearance, and the addition of a little narcissus foliage to each bunch is a considerable improvement. Foliage, however, must not be indiscriminately cut from the growing crop. Only a leaf or two should be selected from each plant; or a cheap vigorous variety such as single *Incomparabilis* may be grown purposely for the supply of foliage. The bloom when cut is benefited by having one night in water before being packed, and, in any case, it should certainly have an hour or two in water before being put into the boxes. The flowers then reach their destination in a much fresher condition than if cut and packed forthwith.

Packing.—Most commission salesmen supply boxes, and into these a certain number of bunches are put. All boxes should be papered, allowing sufficient paper to project over the sides and ends to cover the bloom completely when packed. The boxes should not be unduly crowded, as a lesser number of bunches nicely tied and carefully packed will realise more than an increased number of bunches crowded into a similar box. A small label stating the contents of the box should be tacked outside each, and the boxes then tied in bundles of two or three together. The work of gathering, bunching and packing is generally done by the piece or per gross, and the cost will vary according to the rate of pay in the district, condition of crop, &c. From 1*s.* to 1*s.* 3*d.* per gross bunches is stated to be an average price.

The important points are to get the stems as long as possible, to stand them in water before packing, to bunch and pack them carefully, and not to overcrowd the boxes.

Value of the Crop.

Market prices vary considerably, and it is impossible to estimate these accurately; 9*d.* to 1*s.* per dozen bunches may

be taken as an average, although the small cultivator will find that where special attention is paid to careful picking, packing, and grading, rather higher prices will be obtained. It is in these details that the small grower scores an advantage over the large establishments, where the flowers are apt to be handled with a certain amount of carelessness.

INCOME.	£	s.	d.
200,000 blooms per year for three years at 10*d.* per gross	173	12	0
Value of bulbs at end of three years	150	0	0
	£323	12	0

EXPENDITURE.	£	s.	d.
Gathering, bunching, and packing bloom per year for three years at 1*s.* 6*d.* per gross bunches	26	0	9
Carriage and commission for three years at 55 per cent. on £173 12*s.*	95	9	6
Incidental expenses, clerical, &c., 6 per cent. on £173 12*s.*	10	8	3
Rent, rates, and taxes for three years ...	18	0	0
Manure	15	0	0
Soot (second and third years)	5	0	0
Preparation of land ...	4	0	0
Bulbs for planting ...	75	0	0
Cost of planting ...	4	0	0
Cleaning land (three years)	15	0	0
Lifting bulbs	8	0	0
Cleaning and sizing bulbs	2	0	0
Profit on three years	45	13	6
	£323	12	0

Or an annual profit per acre of £15 4*s.* 6*d.*

In estimating the quantity of blooms obtainable from an acre considerable latitude must again be given, as the crop will vary according to varieties, good or indifferent culture, &c.; 200,000 blooms may be taken as an average yield per acre for the varieties specified, with the exception of *Ornatus*, which may be trusted to give two or three times that quantity. Assuming a crop of this size for a period of three years (the length of time the crop is on the land), the above estimate may be regarded as applicable to the Fenland district, where, as stated above, less expense is incurred in some details than in other parts of the country.

Whitehall Place, London, S.W.,
August, 1909.
Revised, November, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 225.

BOARD OF AGRICULTURE AND FISHERIES.

The Septoria Disease of Tomatoes.

(*Septoria Lycopersici* var. *europaea*, Briosi et Cavara.)

In 1907 and 1908 tomatoes were found to be attacked by a disease which had not previously been known to exist in this country, but which was first reported from South America, the native country of the tomato. As far back as 1884 it was described by Spegazzini, as attacking tomatoes grown in Argentina. Since then it has appeared in Australia; and shortly after the introduction of tomatoes into Europe it was recorded in Italy, France, Germany and other Continental countries. From its sudden appearance in this country there can be little doubt that the fungus has been introduced from abroad with imported tomatoes. The damage which the fungus is capable of doing is very serious. Growers are cautioned to be on the lookout for this pest, which, if neglected, may become one of the most serious sources of injury to tomatoes.

The fungus which causes the disease is closely related to the "leaf spot" disease on strawberries, apples, pears and chrysanthemums, but is quite distinct from any of these diseases, and it has been proved that spores of the fungi causing "leaf spot" on the plants named above are incapable of producing this particular disease on tomatoes. In the same way, experiments made with the object of infecting potatoes and other plants with spores from this tomato fungus have not resulted in any injury.

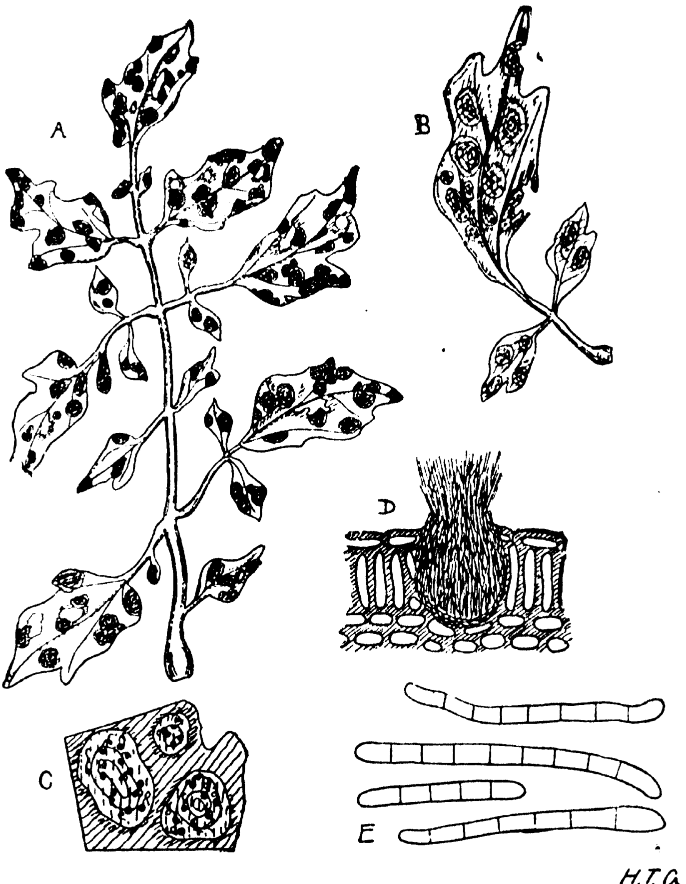
Symptoms of Attack.

The tomato plants attacked show small blackish-green spots on the leaves. These are irregular in shape at first, but soon become concentric and finally confluent, and the leaves, which are rapidly killed, roll up and hang loosely from the stem. The fungus also attacks the stem, the calyx and finally the fruit itself. When no remedial measures are taken the whole plant may be destroyed within seven days from the first sign of the disease.

Description and Life History.

The spores of the fungus germinate out-of-doors during June and July, but at an earlier date under glass; the mycelium pierces the surface of the leaves and rapidly branches in the interior. The injured portions quickly discolour, and small spots appear externally. The dead tissues, especially in tomatoes grown indoors, dry up and exhibit spots of a somewhat dark brown colour, which appear hard and parchment-like. In tomato plants cultivated in the open air the spots

are softer and black. When the dead portions of a leaf are examined by means of a pocket lens, one can easily detect numerous minute black bodies not larger than the point of a needle all over the surface of the leaf. At the same time one can distinguish a light brown-coloured substance rising from the apex of each small body like a curled, twisted thread.



A.—Tomato leaf attacked by the fungus *Septoria Lycopersici*, var. *europaea*.
B, C.—Portions of diseased leaf (magnified).
D.—Section through leaf, showing fruiting conceptacle (magnified).
E.—Spores of the fungus (highly magnified).

The manner in which this substance rises from the bodies may serve as a character to distinguish this disease from others.

The minute black bodies are the fruiting portion of the fungus, and the light brown mass consists of spores. The

spores are exceedingly small, measuring about $\frac{1}{454}$th of an inch in length and $\frac{1}{12500}$th of an inch in breadth; they are divided into several segments, numbering from three to eleven. When the leaves dry up the spores fall to the ground, and are carried about by the air or adhere to the glass, woodwork, poles, &c., of glass-houses, where they pass the winter. They germinate on tomato plants in the following year on finding suitable conditions for their development.

Prevention and Remedy.

Experiment has shown that in order to combat this disease great care must be exercised. The precautionary measures recommended below should be adopted.

(1) Plants once attacked can only be saved by spraying immediately the first signs of disease are noticed. The plants should be sprayed with a 3 per cent. solution of Bordeaux mixture early in the morning every second day for two weeks. The spray should be in form of a fine vapour falling upon the plants like a natural dew. The method of preparing Bordeaux mixture is described in Leaflet No. 23 (*Potato Disease*). The ingredients for a 3 per cent. solution would be 3lb. copper sulphate and 2lb. freshly burnt quicklime to 10 gallons of water.

(2) Badly attacked plants should be cut back, or better still, uprooted and burned.

(3) Any wires and props used in the houses or in the open air should be slowly drawn through fire, in order to kill the spores adhering to them.

(4) The top soil should be removed and mixed with fresh lime in the proportion of one barrowful of lime to five of soil. It can be replaced after the lime has slaked.

(5) When planting young tomato plants, pulverised lime should be scattered on the ground round the stems.

(6) Tomato seed from infected areas should not be used.

A fuller account of this disease was given in the *Journal of the Board of Agriculture* for May, 1908.

NOTE.—Tomato Leaf Spot (*Septoria Lycopersici*, Spegazzini), which is identical with the Septoria Disease of Tomatoes described above, is scheduled by the Board under the Destructive Insects and Pests Acts, 1877 and 1907, and its presence must be at once notified to the officer appointed by the Local Authority to receive such notices, or, if no such officer has been appointed, to the Board. Failure to comply with the provisions of the Destructive Insects and Pests Order of 1910 renders a person liable on conviction to a penalty not exceeding ten pounds. (A copy of the Order may be obtained on application to the Board.)

Whitehall Place, London, S.W.,

May, 1909.

Revised, August, 1911.

BOARD OF AGRICULTURE AND FISHERIES.

Broom-Rape.

Amongst plants which are usually classed as weeds—not merely because they are "out of place" but because they are harmful or of no value—there are several which are parasitic in character, and for certain reasons of an insidious nature. In a previous leaflet (No. 180) an account has been given of the parasite Dodder, and it is now proposed to deal with another plant pest known as Broom-rape. Although it is of less economic importance than dodder, yet in some cases the broom-rape which attacks the clover crop may be the cause of much loss. Several species are harmful to other plants, but only one or two of the more important of these will be mentioned here. Broom-rape is especially troublesome on warm, dry, light soils.

Description of Broom-rapes.

The broom-rapes are included botanically under the order *Orobanchaceæ*, of which there are 11 genera, and according to Bentham and Hooker 150 species; of these about 100 are members of the genus *Orobanche* (or broom-rapes). Few of them, however, occur in the British Islands. Broom-rapes are annual, leafless, brownish root-parasites, containing no chlorophyll or green colouring matter. The base of the stem is somewhat tuberous and scaly; the stems are generally stout and scaly, and usually occur singly; while the flowers, with one or two exceptions, grow in lax or dense spikes. The whole plant is attached, by means of suckers or haustoria, to the roots of the plant upon which it is parasitic.

O. minor, Sutt.—The Lesser Broom-rape, *O. minor*, is the species which is the farmer's especial trouble, as it attacks clover, and may do great harm when established amongst that crop. It occurs on a variety of plants, and is found southwards from the Border counties. The flowers (see sketch) are about $\frac{1}{2}$-$\frac{3}{4}$ in. in length, and are variously described as reddish, purplish or yellowish brown in colour, many flowers being crowded in a long spike. The stem is somewhat slender compared with some other broom-rapes, and from 6 in. to nearly 2 ft. in height. This species flowers from June to October. It is recorded by Kirchner as occurring in Germany on *Trifolium repens*, *T. hybridum*, *T. pratense*, *T. incarnatum*, Serradella, *Lotus corniculatus*, Carrots and Fuller's Teasel (*Dipsacus fullonum*).

O. Rapum-genistæ, Thuill.—This species, known as Larger Broom-rape, is brownish in colour, with flowers about 1 in. in length and of a yellow and purplish tint, flowering taking place from June to August. The flowers occur in dense

spikes. It is found in Great Britain from Dumfries southward, in Ireland, and in the Channel Islands. It is parasitic on the roots of a few shrubby leguminous plants, such as broom and gorse.

O. ramosa, Linn.—Hemp is occasionally infested with this species, whilst on the Continent it attacks tobacco. It is brownish in colour, with light blue flowers, and blooms in September.

O. major, Linn. (= O. elatior, *Sutt.*).—This species of broom-rape is parasitic on composites. Hooker says it is parasitic on *Centaurea Scabiosa*, but is rare. It is found, chiefly in the eastern counties, from York and Durham to Sussex and Somerset, and also in South Wales. The flowers are yellowish and in dense spikes, flowering occurring from June to August.

Several other species occur in this country, but they are of no agricultural importance.

Description of Seeds.

The seeds of broom-rape are exceedingly small and light, almost dustlike, and are contained in two-valved, many-seeded capsules. Several hundred seeds are produced from a single flower. Sorauer quotes Wentz as having seen 70 to 90 seed-capsules, containing on an average 1,500 seeds, on a single plant. Since they are so small, the seeds of this parasite may be separated with ease from clover and other agricultural seeds. When shed from the capsules, however, the seeds are easily distributed by the wind.

Life History.

The seeds only germinate on coming into contact with the roots of a host plant. Some species are confined to one host, while others are found on various plants. The following remarks refer especially to *O. minor*, which is the most important species agriculturally. On germination, the seedlings are threadlike, somewhat resembling those of dodder. The seedling of *O. minor* becomes attached to the roots of the host by means of a sucker, afterwards developing a thick fleshy stem, which appears above the soil "like a pale brownish-red asparagus shoot from 6 in. to 18 inches in length." This stem gives rise to the spike of flowers. By means of the suckers, or *haustoria*, the parasite subsists on the food material elaborated by the host plant for its own use, and may thus cause great damage. In the case of clover the crop may in some cases be practically destroyed.

Prevention and Remedy.

1. The chief means of preventing infection on clean farms undoubtedly lies in using absolutely clean seed, free from weed seeds. Although the seed of broom-rape is easily

a.—**Broom-Rape** (*Orobanche minor*, Sutt.). nat. size; *b.*—Seed of Broom-Rape, nat. size and magnified; *c.*—Seed of *Trifolium pratense*, nat. size and magnified.

removed from clover, on account of its minute size, yet it occasionally happens that samples are not entirely free from the pest, and clover fields may become infested. The second cut of clover is sometimes almost, if not quite, ruined.

2. Wherever the plant is seen it should be pulled up, and this may be done with ease, as the broom-rape readily separates from the clover root. Stebler, however, quotes a case in which after plants had been removed by hand the pest again shot up, and though a workman devoted a fortnight solely to pulling up the broom-rape he could not master the pest.

When it occurs only in small patches it may be dug out and burnt. If allowed to come to maturity the seeds will be scattered broadcast in large quantities. Sorauer says that in case of widespread infestation prevention of seeding is the chief method of combating broom-rape, because spreading by shoots or scions is slow and easily preventable by uprooting the plants.

3. Clover should not be grown on badly infested land until after the lapse of a number of years.

4. Manures which will encourage the growth of the clover and aid it in resisting the attack may be employed with advantage. For example, ground lime and potash manures judiciously applied may be of value in this way.

5. Red clover when badly attacked by broom-rape (*O. minor*) may be replaced by lucerne or sainfoin. The sowing of Italian rye-grass with clover has been found useful, as it grows rapidly after the first cut and retards the growth of the broom-rape. Heavy-yielding varieties of red clover are valuable, their strong, luxuriant and rapid growth tending to suppress broom-rape.

Whitehall Place, London, S.W.,
August, 1909.
Revised, September, 1911.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 227.

BOARD OF AGRICULTURE AND FISHERIES.

Swine Erysipelas.

This disease may be defined as a contagious disease of swine caused by the bacillus of Swine Erysipelas.

Prevalence.

The investigations which have been conducted in connection with swine fever have shown that swine erysipelas, particularly in its milder forms, frequently affects pigs in Great Britain, and that in a certain proportion of cases it is the cause of death.

During the last three years records have been kept by the Veterinary Officers of the Board regarding outbreaks of disease which were reported as suspected swine fever and afterwards found by the visiting veterinary surgeon to be swine erysipelas. These records, which extend to 1,200 such outbreaks annually, show that at least one pig died in each case.

This figure, however, cannot be taken as nearly representing the annual number of outbreaks of swine erysipelas, because in most cases the disease assumes a mild form, and there must be many other outbreaks in which a pig has died without raising a suspicion of swine fever, in which case the fatality would not be reported to the Board. The disease is most frequently met with in fat pigs, that is to say, at a somewhat later age than that at which they are most usually attacked by swine fever.

Symptoms.

Acute cases.—In acute cases of swine erysipelas the animals show the usual signs of severe illness in the pig, viz.: rise of temperature, shivering, loss of appetite, and vomiting. In such cases a fatal termination may take place in 24 to 48 hours, but the animals frequently live much longer. In the less acute cases a red patchy eruption, from which the disease gets its name—erysipelas,—appears on the buttocks, thighs, body and ears.

The breathing is very rapid, and the swine stagger about when made to walk. Ultimately they lie prostrate in the litter and die comatosed.

Mild cases.—In mild cases the general symptoms are not marked; the swine appear to be out of sorts, and show the usual skin eruption, which is sometimes called nettle rash.

Animals which have apparently passed through the acute stages of the disease may remain unthrifty for a long time.

Sometimes they die suddenly from disease of the heart, which is not an uncommon sequel of the disease. In other cases they present symptoms of lameness due to trouble in the joints.

The skin is discoloured by livid patches as in swine fever, but sometimes the only symptoms shown are those of nettle rash. The bacillus apparently can flourish for a long time outside the bodies of animals, so that once the disease is introduced into insanitary styes the infection tends to remain there. For some reason, however, which is ill understood, the disease may assume a very mild form for a time, then burst out acutely. In Great Britain the acute forms have been observed particularly in the warm months.

Post-mortem.—The membranes of the stomach and intestines show red patches, and are often swollen. The intestinal glands on the membrane are red and enlarged; sometimes the surface over these glands is abraded, but the distinct ulcer of swine fever is never seen. The lymphatic glands throughout the body are swollen and red. The spleen is often enlarged.

The membranous coverings of the lungs and heart show red spots, and sometimes water is present in the chest and heart sac.

The lungs are congested.

In the chronic form the tissues around the opening between the chambers of the heart, particularly on the left side, are frequently thickened and rough; that is to say, endocarditis is present.

Prevention and Remedies.

This is a disease against which several methods of protective inoculation have been directed. At the present day it is customary to employ either (1) a preventive serum obtained from horses which have been highly immunised by the injection of large quantities of pure cultures of the bacillus of swine erysipelas, or (2) a combination of specified doses of preventive serum and pure cultures of the bacillus.

The immunity conferred by the serum alone begins immediately, but it lasts for little more than ten days. Apparently, however, it exerts a protective action even when used in the initial stages of infection. The immunity conferred by inoculating with both serum and pure culture lasts a much longer time, probably six months and even longer. Leclainche, who has been foremost in elaborating this method of protective inoculation, advises that where the disease has already broken out the pigs should receive a preliminary injection of serum, 10 to 20 c.c. according to weight. This, he states, greatly reduces the number of

accidents consecutive to vaccination proper, that is to say, with the combination of pure culture and serum which is performed about ten days afterwards. The vaccination proper consists of two operations. The first is performed with a mixture [made on the spot] of serum—1 c.c. per 20 lb. live weight, with a minimum dose of 5 c.c. and a maximum of 10 c.c.—and ·8 c.c. of a pure culture. Twelve days later the second operation is performed, when the animal receives ·8 c.c. of a pure culture without any serum. The materials are injected subcutaneously, either at the base of the ears or inside the thighs. During a period of 18 months ending November, 1901, Leclainche had under observation 24,000 pigs which had been inoculated by his method; about one-half of these were treated by a preliminary injection of serum alone. Not a single accident was recorded.

Lorenz has reported observations on 22,161 pigs which were inoculated in Eastern Prussia by the combined method (serum and culture), and 3,831 of these pigs were on farms on which the disease had already broken out. In the latter there were no fresh cases of swine erysipelas after inoculation; 50 per cent. of recoveries were recorded in sick animals after the injection of serum alone (1–4 doses). Nettle rash, which is a mild form of swine erysipelas, occurred in ·04 per cent. of the inoculated animals. The disease disappeared from the farms after inoculation was adopted, whereas it had appeared at regular intervals before that time.

Recommendations.

1.—It is not advisable to resort to inoculation of pigs on non-infected premises unless the circumstances are such that owing to the proximity of acute outbreaks it appears practically impossible to prevent the disease being introduced by methods of rigorous isolation, because the operation might possibly be the means of infecting the premises.

2.—Should the disease appear, however, all the pigs should with the least possible delay, receive a dose of serum, and those in which the temperature is normal should be removed to non-infected styes on the same premises, if this be practicable. Ten days afterwards the vaccination proper may be practised after the method of Leclainche (serum and virus, then virus alone) on those animals still showing a normal temperature. The pigs with high temperatures should be returned to the infected styes, and if their value warrants it they should be treated by injections of serum alone. On no account should they receive the culture. If it be found impossible to separate the sick from the healthy the operations should be carried on in the infected styes.

3.—Although this disease can to a large extent be successfully combated by inoculation, it must not be thought that measures of isolation and sanitation can be dispensed with. While the outbreak lasts no new pigs should be brought in, and none should leave the premises except for slaughter under the most rigorous precautions against the disease being conveyed to other premises. If a pig owner finds that the disease reappears annually on his premises he should resort annually to preventive inoculation, timing the operation so as to have his animals immunized before the season of greatest activity. He should also remember that the complete eradication of the disease from his premises will be greatly facilitated by keeping his pigs in styes which can be properly disinfected.

Although swine erysipelas can hardly be regarded as a very fatal disease of pigs, in Great Britain at least, the Board have been informed that it often interferes materially with the marketing of pigs, since it frequently attacks them and causes considerable emaciation close to the time when they are expected to be ready for market. In such cases owners have been advised to immunize their pigs by methods of inoculation about three months before they are expecting them to be ready for market. From information received from those who have put this advice into practice, it would appear that the adoption of preventive inoculation has given excellent results.

As swine erysipelas is not a disease notification of which is required by Order of the Board, it should be borne in mind that a pig suffering from that disease may also be affected with swine fever, and that the Swine Fever Order of 1908 requires that every person having in his possession or under his charge a pig affected with, or suspected of swine fever shall give notice to the police. In this connection attention is called to the "Notice to Pig Owners" issued by the Board.

Whitehall Place, London, S.W.
December, 1909.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

Leaflet No. 228.

BOARD OF AGRICULTURE AND FISHERIES.

Prevention of Cruelty to Animals.

The Board of Agriculture and Fisheries desire to draw the attention of agriculturists to certain Acts which relate to the prevention of cruelty to animals, and in particular to the provisions relating to the use of traps and snares for rabbits, hares, &c. Any carelessness in trapping which may lead to suffering in the animals caught deserves severe censure, and the Board think that a considerable amount of suffering might be prevented if the provisions in existing Acts of Parliament were more generally known and more strictly enforced.

Protection of Animals Act, 1911.

This Act applies to England and Wales, and, with certain modifications, to Ireland, but does not apply to Scotland, as to which very similar provisions have been enacted by the Protection of Animals (Scotland) Act, 1912. The Act of 1911 came into force on January 1st, 1912.

Among the offences of cruelty constituted by the Act, and which involve severe penalties on conviction, are (1) causing unnecessary suffering to an animal by wantonly or unreasonably doing or omitting to do any act; (2) conveying or carrying an animal in such manner or position as to cause it unnecessary suffering; (3) wilfully and without reasonable cause or excuse administering to an animal any poisonous or injurious drug or substance; and (4) operating on an animal without due care and humanity.

Penalties may also be inflicted on persons who cause or procure any such acts or omissions, and on the owners of animals if they fail to exercise reasonable care and supervision in respect of the protection of the animals from cruelty.

The section which deals with these matters does not apply to :—

(*a.*) The commission or omission of any act in the course of the destruction, or the preparation for destruction, of any animal as food for mankind, unless such destruction or such preparation was accompanied by the infliction of unnecessary suffering; or

(*b.*) The coursing or hunting of any captive animal, unless such animal is liberated in an injured, mutilated, or exhausted condition; but a captive animal is not considered to be coursed or hunted before it is liberated for the purpose of being coursed or hunted, or after it has been recaptured, or if it is under control.

The section applies not only to domestic animals, but also to any animal which is in captivity or confinement, or which is maimed, pinioned, or subjected to any appliance or contrivance for the purpose of hindering or preventing its escape from captivity or confinement.

In any case of a conviction of an owner for an offence of cruelty to his animal, the court is given the power to direct that the animal shall be destroyed at the expense of the owner if upon the evidence of a duly registered veterinary surgeon it is shown to be cruel to keep the animal alive. If it is shown that the animal would be likely to be exposed to further cruelty if left with its owner, he may be deprived by the court of the ownership of the animal. The owner of an animal may obtain compensation not exceeding ten pounds for the damage or injury caused to his animal by a person convicted of the cruelty which has caused the damage.

Animals in Pounds.—Impounded animals must be fed and watered by the person impounding them, under the penalty of a fine ; and if impounded animals are left without sufficient suitable food or water for six hours or longer, anybody may enter the pound and feed and water them. In either case the cost of the food or water is recoverable from the owner.

Use of Poisons.—A person is liable under this new Act to a penalty if he (*a*) sells, or offers or exposes for sale, or gives away, or causes or procures any person to sell or offer or expose for sale or give away, or knowingly is a party to the sale or offering or exposing for sale or giving away of any grain or seed which has been rendered poisonous except for *bonâ-fide* use in agriculture ; or (*b*) knowingly puts or places, or causes or procures any person to put or place, or knowingly is a party to the putting or placing, in or upon any land or building any poison, or any fluid or edible matter (not being sown seed or grain) which has been rendered poisonous.

In any proceedings under paragraph (*b*) it is a defence that the poison was placed by the accused for the purpose of destroying rats, mice, or other small vermin, and that he took all reasonable precautions to prevent access thereto of dogs, cats, fowls, or other domestic animals.

This provision is, in its application to Ireland, modified by Section 17 (2) of the Act.

Spring Traps.—Any person who sets, or causes or procures to be set, any spring trap for the purpose of catching any hare or rabbit, or which is so placed as to be likely to catch any hare or rabbit, is liable to a penalty if he does not inspect, or cause some competent person to inspect, the trap at reasonable intervals of time, and at least once every day between sunrise and sunset.

Use of Dogs for Draught Purposes.—Any person who uses, or causes or procures, or, being the owner, permits, to

be used, a dog for the purpose of drawing, or helping to draw, a cart, carriage, truck or barrow on a public highway is liable to conviction under the Act.

Compliance by Knackers with certain Regulations.— Knackers are required by the Act to comply with certain regulations as to the treatment of animals while in their charge, and as to the keeping of books containing full particulars in connection with the animals dealt with. Children under sixteen years of age may not be admitted to, or permitted to remain in a knacker's yard during the process of slaughtering or of cutting up a carcass.

Ground Game Act, 1880.

The effect of the provisions of the Ground Game Act, 1880, which give occupiers a right to kill hares and rabbits on their lands, is to limit the right to the occupier and persons authorised by him in writing.

It is therefore possible for farmers to assist in the prevention of cruelty by exercising discretion in authorising persons to trap hares and rabbits, and by seeing that such persons properly attend to the traps which they set, so that animals are not allowed to remain in the traps for any long period. The Board believe that much good could be done in this way.

Section 6 of the Act provides that no person having a right of killing ground game under the Act or otherwise shall use any firearms for the purpose of killing ground game between the expiration of the first hour after sunset and the commencement of the last hour before sunrise; and that no such person shall, for the purpose of killing ground game, employ spring traps except in rabbit holes, or employ poison; and any person acting in contravention of this section is, on summary conviction, liable to a penalty not exceeding two pounds.

In any case to which this section applies, if a spring trap is employed for the purpose of taking hares and rabbits, it must be set actually in the rabbit hole; and it has been held in a Scotch case that "rabbit hole" does not include the run at the mouth of the hole, but is confined to "that part of the burrow which is inside the ground and covered by the roof" (*Brown* v. *Thompson, 1882, 9 Rettie Court of Session Cases, 1183*).

Spring traps must be inspected frequently in accordance with the provision in the Act of 1911 which is referred to above.

The spring trap, however, is in any case an exceedingly unsatisfactory and undesirable means of catching ground game, and, in the Board's opinion, should not be used.

The Board have been advised that a humane rabbit trap can be made by a simple adaptation of the ordinary "wire" trap or snare. In the ordinary snare strangulation certainly takes place, but it seldom occurs immediately, and the animal may continue to struggle for a time. If a very small eyelet ring ($\frac{3}{32}$ in. in diameter) be inserted in the loop through which the wire passes, and a simple knot be tied in the wire so as to leave $5\frac{1}{2}$ to $6\frac{1}{2}$ inches between it and the small loop through which the wire is passed to form the snare, it will prevent the wire being pulled up too tightly. A loop about $1\frac{3}{4}$ to $2\frac{1}{8}$ inches in diameter will thus be left round the neck of the trapped rabbit, which, it is stated, is secured without being strangled, a further advantage being that the rabbits thus caught are in a better condition for purposes of sale.

Wild Birds Protection Acts.

The use of pole-traps is prohibited by the Wild Birds Protection Act, 1904, section 1 of which enacts that every person who, on any pole, tree, or cairn of stones or earth, shall affix, place, or set any spring, trap, gin, or other similar instrument calculated to cause bodily injury to any wild bird coming in contact therewith, and every person who shall knowingly permit or suffer or cause any such trap to be so affixed, placed or set, shall be guilty of an offence, and shall be liable on summary conviction to a penalty not exceeding forty shillings, and for a second or subsequent offence to a penalty not exceeding five pounds.

The use of hooks or other similar instruments for taking wild birds is an offence under the Wild Birds Protection Act, 1908.

The trapping of wild animals in general has not been made the subject of legislation, but the desirability of employing a type of trap calculated either to cause immediate death or to secure the animal without injury is obvious, and the Board trust that all lovers of animals will do their utmost to prevent the use of cruel traps.

Assistance by the Public in enforcing Acts.

The enforcing of these Acts would be facilitated if persons who see any infringement of their provisions would immediately communicate with the Police or an Inspector of the Royal Society for the Prevention of Cruelty to Animals.

Whitehall Place, London, S.W.,
October, 1909.
Revised, June, 1914.

Leaflet No. 229.

BOARD OF AGRICULTURE AND FISHERIES.

The Breeding and Rearing of Turkeys.

For a considerable time the eastern counties of England have produced the greatest number and the finest specimens of turkeys. Probably more of these birds were reared in Norfolk and Cambridgeshire than in all the other counties combined. Latterly, however, there has been a considerable extension of the area over which this branch of poultry-keeping is carried on. Suffolk produces an increasing quantity every year, and the industry is extending elsewhere, though not very rapidly. The special feature of East Anglia is that within what may be termed the turkey districts flocks are raised every year by an increasing proportion of farmers, with the result that the sale can be organised on lines which facilitate marketing. Where only one or two farmers have birds for sale it may be more difficult to dispose of the produce.

The demand for turkeys has increased very largely, and there has also been a notable lengthening of the season of consumption. Very early birds are usually foreign, as are those offered for sale in the late winter and early spring months. There is, however, a moderate enquiry for turkey poults from July onwards, and one which might be greatly stimulated were supplies of good quality available. In America "squab turkeys" are largely in demand from June onwards. These are young birds three to four months old, for which high prices are paid, as they are very delicate eating. If the demand for these birds were increased, as it might be, farmers could hatch a much larger number, kill off at that stage about half their young stock, and reserve the remainder for winter sale. By so doing their returns would be increased. The principal demand, however, is from the middle of December to the end of January, prices ranging highest for birds intended for Christmas consumption, when the larger birds are at a premium if of good quality, as the price per pound rises as the weight increases. Taking the season through, however, birds of medium weight find a readier sale, the majority of consumers preferring specimens weighing from 10 to 14 lb. Those who breed the larger birds should have these ready for the Christmas trade.

Even for the Christmas trade the demand for the largest birds is not now so great, as it is realised that the medium-sized birds are finer in flesh. It is true that there is still a considerable demand on the principal markets at the Christmas season for cock birds weighing 20 to 25 lb., and hens weighing 14 to 18 lb., but the great majority of consumers prefer smaller specimens, which are more in

conformity with their means. If the season of consumption should be more generally extended, it can only be brought about by increasing the supply of medium-sized turkeys offered for sale. The excess of demand over supply for the Christmas trade has led to breeders and feeders killing for that season alone. With greater production it will be desirable to equalise the supply from October to February, reserving the finest specimens for Christmas sale.

As turkeys are soon affected by tainted soil, and require an abundance of natural food, turkey rearing is best suited to the larger farmer, who is able to give plenty of range to the breeding stock, and to distribute the young birds over the land. Where the bulk of the food is produced upon the farm the cost of rearing is also much less than upon pasture farms, and as the period of growth extends over from seven to nine months this is an important consideration. The presence of copses or woods is a desirable feature, more especially during the summer, shelter from excessive heat and a supply of natural food being both provided.

Suitable Situations.

Although turkeys may be raised on heavy land the operation is difficult, particularly in a wet season, and as a rule they do better on the lighter soils, except in very dry weather, when there may be some deficiency in the green food. The best results are obtained upon a rich soil, which is not absolutely heavy in character. Arable land is to be preferred, and it is a notable fact that many of the most successful turkey breeders have most of their land under the plough. Upon some farms a choice of position is possible. Where this is the case preference should be given to a dry and sheltered position, facing south and protected from cold winds.

Young turkeys will not thrive in cold, bleak positions, and every advantage must be taken of banks, hedges, woods, or belts of trees, which will serve as wind breaks. If these are not available, wattle and faggot screens may be temporarily erected to the windward of the coops. Although this involves some trouble, it enables the rearing to be conducted under healthier conditions than if sheds or buildings are used. The open air method of rearing is essential to health and soundness of constitution; indeed, the more natural the system adopted the greater is the probability of success.

Varieties.

The American Bronze turkey most nearly resembles its wild progenitor, and good strains attain an average weight of about 25 to 30 lb. in the cock birds and 16 lb. in the hens. In appearance this breed is very handsome, the neck, breast and back being black, shaded with a glistening bronze. The

under parts are less richly coloured. The wings are black, barred with white or grey and edged with white, the wing bow having a greenish or brownish lustre. The tail is black with brown pencilling, and the coverts grey, shading into black and ending in a brown band. The face, ear lobes and wattles are a rich red, and the legs long and dark in colour. Whilst the flesh is abundant, it lacks the fineness of texture found in other breeds, and the popularity of the American Bronze has been mainly due to its greater vigour and weight.

At one period the class of turkey chiefly kept in the eastern counties of England was that known as the Black Norfolk. This variety is now, however, very seldom seen. In size the larger birds are about 22 lb. in the males, and 14 lb. in the females. With the demand for larger specimens at Christmas it decreased in favour. Demand for weight, however, was not the only reason, for, although the flesh is very fine indeed, the breed does not possess the vigour of constitution found in the American Bronze. The plumage is a dull black, with brown or white tips to the feathers on the back and wings. A Black Turkey, very similar in size and flesh qualities to the Norfolk, but hardier, is bred throughout Normandy and Northern France. Its plumage is a deep, glossy black.

In various districts in eastern England may be found a variety known as the Cambridge Bronze, which is both larger in size and finer in bone and texture of flesh than the American Bronze. It has been produced by crossing the Black with a grey turkey at one time common in Cambridgeshire. With this cross the Copper or Brown and finally the American Bronze were mated, thus producing a breed which is one of the finest known. The body is shorter than in the American, but deep and massive. The plumage is of a dull bronze with grey or white tips to the body feathers, the wings and tail barred with the same colours. In ordinary condition males reach 20 to 24 lb., and females 12 to 16 lb., but they fatten up readily to much heavier weights.

The White turkey is now much more commonly seen than it was a few years ago, the popular prejudice of breeders against white plumage which was believed to imply delicacy of constitution, having to some extent been overcome. In Southern Europe this breed is very extensively kept, and the feathers are more valuable than those from coloured birds. White turkeys as a rule are small in size, though they vary considerably. A very useful cross may, however, be made by running a bronze male of medium size with white hens. The young birds are curiously speckled in appearance, but have been found hardy, and comparatively easy to rear, attaining a useful marketable size where exceptional weight is not required.

Housing.

The natural instinct of adult turkeys is to roost in trees, but this is not always permissible in a country in which foxes are more or less plentiful. As delicacy and disease, however, are the direct result of badly ventilated or overheated sleeping quarters, it is preferable that the breeding stock shall roost in the open all the year round, where it is safe for them to do so. Special protection may be necessary, but that is better than placing the roosts under cover. Where large trees are available the birds may be permitted to roost on the branches if strong enough for them. Otherwise perches should be placed under the trees, so made that they can be easily removed. These should be of fir poles, broad enough for the birds to grip firmly, and be raised three feet above the ground. Old disused large waggon or cart wheels make excellent perches for turkeys if placed horizontally at the height named, and may be used either in or out of doors.

Where turkeys must for any reason be accommodated under cover a special form of house is necessary, because they require an abundance of fresh air. The floor must be dry, and the roof should, if possible, be thatched and lofty. The walls should preferably be made of wattled furze about a couple of feet thick, as this ensures both perfect ventilation and fresh air without draught.

Turkeys always prefer to remain on their perches until let out in the morning, when it is their habit to fly straight out and alight on the ground at some distance in front of the house. For this reason and to prevent the birds damaging themselves, the greater part of the front of the house should be made to open with folding doors or gates consisting of strong frames, hung on hinges and covered with wire netting. It is only from stock housed in a healthy open-air manner that a healthy progeny can be expected.

The Breeding Stock.

Many failures have been primarily due to in-breeding, and the use of immature stock wanting in stamina. A well-bred and well-grown cock for mating is of the first importance, and close-breeding should be avoided. Well-grown birds for breeding are not necessarily of great size. An approximation to 20 lb. in the males and 15 lb. in the females would be suitable weights for ordinary breeding purposes, other considerations including width of shoulders, contour of breast, and a medium length of leg. The practice of feeding all the young birds in the same manner, and retaining a few for breeding after fattening, is a bad system.

The stock birds should preferably be from two to three years old, and from six to eight hens may be run with a vigorous cock, although a more usual proportion is four or five hens. Yearling hens should not be used for breeding, but may be employed as mothers during the first season. One service is usually sufficient for the fertilization of a batch of eggs, but permanent mating is preferable.

During March the hens require watching or they will choose some out of the way spot in which to nest. It is advisable to place boxes or barrels on their sides in sheltered positions, in which the birds may lay. April is the best hatching month, and it is generally inadvisable to continue hatching beyond June. Although late birds have insufficient time to come to full maturity, they may be disposed of as poults. Turkey hens are usually good mothers, but their eggs may also be hatched under ordinary hens. Artificial methods of hatching and rearing are not recommended, though incubators are frequently used at the time of hatching. A turkey hen will cover from fifteen to sixteen eggs, and a large barn-door hen from eight to ten. The period of incubation is twenty-eight days. The nests should be upon an earth bottom, and the general management should be similar to that in the case of ordinary hen's eggs.

Feeding Stock Birds.

The correct feeding of the stock birds has an important bearing upon the result. If the food be too fattening the male will fail to fertilize the eggs and the hens will be liable to become egg-bound owing to broken or shell-less eggs in the oviduct. The dietary must necessarily vary according to the weather and conditions, but a suitable mash may be prepared by using equal parts of ground oats, barley meal and middlings to which 5 to 10 per cent. of meat meal may be added, with grain at night. Some breeders prefer a whole grain diet for both morning and evening feeding, using wheat, barley and oats (a greater proportion of the last named grain), and adding cabbage and such roots as swedes, when the pasture is poor, but considerable variation is possible and necessary, according to the character and condition of the range. Over-feeding should be avoided, and the food made as plain as possible. Much will depend upon the supply of natural food available. Where this is plentiful a supply of grain as stated above will suffice, but when natural food is scarce some soft food in which meat has been mixed should be given three or four days per week. From January onwards breeding turkeys require to be in lean condition, and to this end they must have abundant exercise. The importance of a generous supply of grit and oyster shells should be emphasised.

Rearing.

The principle of the roost house should, as far as possible, be applied to the coops, the doors of which should be wire netted and covered with sacking in severe weather if necessary. The birds should be cooped with their natural or foster mothers in a dry, sheltered position with a sunny aspect; a rich, medium soil is the most suitable for them. The coops must be moved a short distance daily to a fresh patch, and the hens allowed out with the young birds when possible. Upon pasture farms the coops should be placed upon short, fresh grass, where the soil is quite sweet, and for the first few days they should be fitted with enclosed runs in front, otherwise the young birds are liable to wander away. Upon arable farms a better plan is to plant the rearing field with rye grass or oats, and when the crop is well up, lanes can be cut north and south with a mower, and the coops be placed in these. The birds will thus get a maximum of sunshine, winds will sweep overhead, fresh ground will be ensured, and there will usually be an abundance of seeds for the chicks, which will be kept fully employed.

A suitable food for turkey chicks consists of steamed rice and biscuit meal, dried with fine sharps; as an alternative some rearers start their birds with curds and fine oatmeal. They may, however, be reared from the time of hatching upon Sussex ground oats in the same manner as chickens are in the south-east, and with equal success. With any soft food an admixture of finely chopped dandelion leaves is especially beneficial—the whole being sprinkled with fine sharp grit and a little powdered vegetable charcoal. The feeding should be commenced early and continued until late in the day; not much food is required at one time, but it is necessary to give it at frequent intervals, commencing with six meals daily.

At about the third week the diet may be changed to include most of the foodstuffs given to ordinary chickens.* Boiled wheat is also a useful food during the early days, although it is too expensive a diet for any but the grower to adopt to any extent. Later on the new corn is helpful, the birds being subsequently run upon the stubbles. Turkey chicks must at all times be comfortably cooped or housed at night, and it is important to keep them dry during their early days. Unless plenty of natural food is available a proportion of meat should be included in the ration. During the summer months woodlands and spinneys are of great value for turkeys, for they not only provide much natural food but are cool and sheltered. Care must be exercised,

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* *See* Leaflet No. 114 (*The Feeding of Poultry*).

however, where foxes abound. Where possible it is always wise to allow the young turkeys after they are three months old to roost in trees or on outside perches already described, as they thrive better under these conditions.

Fattening.

The selection and separation for stock purposes should be made in the autumn, preference being given to birds of good frame and stout legs rather than merely heavy specimens. Those carrying much flesh generally possess small bones, and are more suitable for fattening than for stock. The birds intended for fattening should not be shut up until some time in November. Up to that time they should be allowed the run of the fields, and receive, in addition to any natural food which they may find, a liberal ration of ground oats. The birds which respond most satisfactorily to the fattening process proper are those which have been kept in good condition from their earliest days.

About a month before they will be required for market they should be confined in a large open-fronted shed, situated in a quiet position. An abundance of soured skim milk or butter-milk is necessary to give that colour and mellowness of flesh desirable for the best trade, and to stimulate, by the acid in the milk, the appetite which might otherwise fail during the final process. Sussex ground oats,* wheat meal, buckwheat meal and barley meal are usually employed, and in many cases cooked potatoes or beetroots are mixed with the meal in the proportion of one part of the roots to two parts of meal. To this is added enough soured skim-milk or butter-milk to make the whole into a porridge about the consistency of very thick cream, perfectly smooth and thoroughly mixed. The food should be allowed to stand several hours before it is used, so that a slight fermentation may take place; ½ oz. of pure fat may then be added for each bird. During the fattening period some of the best feeders give rice boiled in milk as an alternative, to whiten the flesh. For the evening wheat, oats or barley steeped in meal are often fed in place of the mixture given above, though many feeders prefer soft food entirely. Plenty of grit, to which may be added small pieces of vegetable charcoal, should be supplied in a box or hopper so that the birds may use as much as they desire. If necessary, cramming may be resorted to during the latter

* This poultry food is made by grinding oats into a fine meal. The special finely-ground product required is obtained by mixing a small proportion of barley with hard flinty oats. Russian and other foreign oats are usually employed in preference to the softer home-grown grain.

portion of the period, but when the birds are in good condition at the commencement of trough feeding, cramming is in most cases unnecessary.

Marketing.

Turkeys should be killed by dislocation of the neck after starving for 24 hours. They should be plucked while still warm, the feathers being drawn in their own direction. The bird should be plucked clean except for the neck and flight feathers, which are usually left on.

The method of tying and shaping is subject to local modifications and the requirements of the markets.

Turkeys should be sent to market laid breast downwards on clean straw and packed tightly in baskets or strong crates, to prevent movement while in transit. Clean butter paper may with advantage be placed above and below each layer of birds to prevent the straw marking and rubbing them. The number and actual weight of the contents, as well as the name of the sender, should be marked on the outside of each package, and a postcard should be sent to the buyer or salesman stating by what route and train the crate is being sent. Many of the large stores arrange for the birds to be dispatched direct to their customers from the farms, in which case they are packed in single hampers.

At the London markets turkeys fetch high prices according to size, appearance and straightness of breast bone, at and for a very short time after Christmas. At Smithfield (Central Market), Tuesdays, Thursdays and Fridays are the best days for selling; at Leadenhall, Mondays, Wednesdays, Thursdays and Saturdays.

The following table showing the periods of demand and weights required at various markets has been compiled from information collected by the Board's Market Reporters :—

Market.	Weights in most demand.	Season.	If fatted.	Average prices. (1914.)
	lb.			per lb.
Birmingham ...	12–15 at Christmas.	Oct.–Feb.	Ordinarily fed	8*d*.–10*d*., 10*d*.–1 at Christmas.
Brighton ...	10–16	Oct.–Feb.	Yes	9*d*.–1*s*.
Bristol ...	Hens, 8–12 Cocks, 12–16.	Nov.–Feb.	Well fatted	Hens. 9*d*.–10*d*.; Cocks, 9*d*.–10½ wholesale.
Carlisle ...	12–16 (dressed)	Nov.–Jan.	Not artificially	8*d*.–10*d*. liv weight, whole sale, 1*s*.–1*s*. 1 retail.

Market.	Weights in most demand.	Season.	If fatted.	Average prices (1914.)
	lb.			per lb.
Chester ...	10–14	Dec.–Feb.	Natural feeding.	1*s*.
Chichester ...	Hens, 10–12 Cocks, 16–18.	Christmas Easter.	Fatted, but not crammed.	Hens 10*d*.; Cocks, 1*s*.
Darlington ...	12–16	Christmas–end Jan.	Ordinarily fatted.	10*d*.–1*s*.
Derby	Hens, 10–15 Cocks, 16–20.	Christmas	No	9*d*. 1*s*. 2*d*.
Dorchester ...	12–20	Christmas	Yes	10½*d*.–1*s*.
Hereford ...	12–14	Christmas	Yes	11*d*.–1*s*. 2*d*.
Hull	Hens, 10 Cocks, 20.	Christmas	Ordinarily	10*d*.–1*s*.
Ipswich ...	10–18	Christmas	Yes	11*d*.–1*s*. 1*d*. wholesale, 1*s*. 1*s*. 3*d*. retail.
Leeds and Bradford.	12–15	Christmas and winter months.	Yes	10*d*. 1*s*.
Leicester ...	Cocks, 16–20 Hens, 12–14.	Christmas	Ordinarily	1*s*. 1*s*. 2*d*.
Lincoln ...	10–20	Dec.–Jan.	Ordinarily	11*d*.–1*s*. 1*d*. wholesale, 1*s*.–1*s*. 2*d*. retail.
Liverpool ...	Cocks, 12–15 Hens, 8–10.	Oct.–March	Ordinarily fed	8*d*.–11*d*. wholesale, 10*d*. 1*s*. 1*d*. retail.
London ...	Cocks, 12–16 Hens, 8–12.	Nov.–March, especially Christmas.	Well fed, fatted at Christmas.	10*d*.–1*s*., more at Christmas.
Manchester ...	Hens, 6–8 Cocks, 10–16.	Christmas	No	7*d*. 10*d*. wholesale, 9*d*.–1*s*. retail.
Newcastle ...	12–15	Nov.–Feb., esp. Christmas.	Yes	10*d*.–1*s*.
Newport, Mon.	Hens, 10–12 Cocks, 14–18.	Nov.–March, especially Christmas.	Well fatted	10*d*.–1*s*. wholesale, 1*s*.–1*s*. 2*d*. retail.
Norwich ...	20–25	Christmas	By ordinary methods.	11*d*.–1*s*. 2*d*.
Penzance ...	10–18 (dressed).	Christmas	Well fatted, but not crammed.	1*s*. 1*d*.–1*s*. 4*d*.
Peterborough	15–20	Christmas	Ordinarily	10*d*. in feather, 1*s*. dressed.
Plymouth ...	16–20	Christmas	Well fed, not crammed.	10*d*.
Portsmouth ...	7–18	Oct.–March	Yes	8*d*.–1*s*. 3*d*.
Shrewsbury ...	12–15	Christmas	Yes	8*d*.–1*s*. in feather, 1*s*.–1*s*. 6*d*. dressed.
Wakefield ...	10–20	Christmas	Ordinarily	1*s*. 1*s*. 3*d*.
Wolverhampton	12–14 (dressed).	Dec.	No	12*s*.–14*s*. (each, dressed).
York	10–16	Christmas	Not artificially	1*s*.–1*s*. 2*d*. retail.

hitehall Place, London, S.W.,
January, 1910.
Revised, May, 1915.

Leaflet No. 230.

BOARD OF AGRICULTURE AND FISHERIES.

Tomato and Cucumber Canker (*Mycosphaerella citrullina*, Grossenb.).

A disease which proves very destructive to melons in the United States of America has recently been described by Grossenbacher. It is caused by the fungus *Mycosphaerella citrullina*, Grossenb., and is indicated by the wilting of the leaves, followed by the entire collapse and death of the plant. In Great Britain it has during the past few years attacked cucumbers, melons and tomatoes, but chiefly the last named.

When a diseased tomato plant is examined, a greenish-brown appearance is often found where the first leaf was stopped. In the early stages this point is moist and rather gummy, while later it becomes brown and hard. This diseased portion usually grades into the normal green appearance of the stem, and is not sharply marked off as is usually the case when *Botrytis* has attacked the plant. In a few cases the attack starts higher up the stem.

At a later stage the diseased patches change to an ashy-grey or whitish colour, and the epidermis or outer coat of the plant may become broken up and studded with numerous perithecia (or cases containing spores) belonging to the conidial stage of the fungus. This is followed by the production of the second (ascigerous) condition of the fungus when the host is dying or dead. The latter has recently occurred in abundance in this country.

Infection experiments proved that the spores of the fungus could infect uninjured melon and other allied plants, though the cucumber proved immune, and resisted all attempts at infection in the United States.

Diseased tomato plants were first received at Kew in 1909 from Waltham Cross. In each case the base of the stem was considerably shrunken, and the cortex destroyed and studded with numerous minute perithecia, which proved to be identical with the conidial or *Ascochyta* stage of the American melon disease. In some specimens the nodes or joints of the stem were also attacked.

Almost simultaneously with the tomato specimens, a diseased cucumber plant which showed the whitish diseased nodal portions of the stem, characteristic of the American melon disease, was received from Gloucestershire. Numerous minute perithecia, which proved to be those of the *Ascochyta*, were present on the diseased patches.

Recent investigations show that the disease was present in Scotland even before 1909.

It has also attacked tomatoes grown out-of-doors in Cambridgeshire, Middlesex and Gloucestershire. In the latter county it was found on the fruit.

Cucumber plants attacked by this disease are stated to be quickly killed outright. Experiments conducted at Kew show that the spores from diseased cucumber plants infect young tomato plants, and that spores from a tomato plant would infect vegetable marrow plants. In both instances the plants infected showed the conidial (*Ascochyta*) stage of the fungus within a fortnight, and in both the injury done was characteristic.

Both in this country and in the United States the conidial form of fruit is responsible for the rapid extension of the disease.

Tomatoes may be attacked at any period of their growth, but the greatest losses usually take place about the end of July when the attack may become epidemic. This is the time when most of the plants are ripening their first truss. The lower part of the stem will then show the gummy appearance and when the plant is dead or nearly dead the stem at that spot will be found to have shrunk. It is possible when plants first wilt to keep them alive for a few weeks by either sinking them in the soil or by piling up earth round the stem. Adventitious roots are then formed and the plant is enabled to ripen a few of its fruits, but this proceeding is not recommended.

Prevention.

The result of preventive experiments conducted in this country is not yet recorded. According to Gressenbacher, spore inoculations conducted in the field were almost complete failures, and it is considered that the very moist, warm environment of the greenhouse is essential for the infection and development of the fungus at any rate in an epidemic form. Further experiments showed that the spores of the fungus are neither killed by exposing infected soil to the weathering conditions of winter, nor by fumigation with hydrocyanic acid gas.

Very few experiments on the prevention of this disease have been made in this country and it is not yet certain if plants are only infected through wounds. It is suggestive, however, that in so many cases, disease apparently starts at the point where the first leaf is stopped, and it will probably pay growers to touch such wounds when made with a brush dipped in some solution which would stop "bleeding." Spraying at this stage with Bordeaux Mixture would probably also do good, but it cannot be used after the fruits have grown to any size. If the disease becomes epidemic, spraying with liver of sulphur (½ oz. to one gallon of water) should be resorted to when the fruit is larger, but the spray should be applied very finely or the disease will be spread by the washing of spores on to other plants. This fact should also be borne in mind when plants are being watered by a hose.

TOMATO CANKER.

In most instances the disease does not appear to become epidemic for the first year or two, but growers should carefully watch for it, and as soon as a plant is attacked by this or any other disease it should be pulled up and burnt. Present indications seem to show that this disease only becomes dangerous through neglect, and if a grower leaves his dead and dying plants about to infect the soil, he must look for trouble in future years. Where the disease has taken an epidemic form all the plants should be burnt and the soil removed or thoroughly sterilised.

When the same soil is used year after year, it should be sterilised at the end of each season by soaking it thoroughly in a solution consisting of one pint of 40 per cent. formaldehyde in 12 gallons of water, or by other suitable means.* Sowing or planting should not take place for a week or ten days after treatment.

Growers should note that this disease is one of those scheduled under the Destructive Insects and Pests Order of 1910 and should be immediately notified to the Board by the occupier of any premises in which it appears.

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* See *Journal of Board of Agriculture*, January, 1913, "Partial Sterilisation of Soil for Glass-house Work."

Whitehall Place, London, S.W.,
February, 1910.
Revised, November, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 231.

BOARD OF AGRICULTURE AND FISHERIES.

Cheese-making for Small Holders.

The standard English cheeses, such as Cheddar, Cheshire, and Derby, are too large for the small-holder to make, as he does not usually have more than 7 to 10 gallons of milk daily, and only a portion of this is available for cheese-making. In addition, the utensils required for making the larger cheeses are expensive, and the process of manufacture is difficult, so that the small holder must confine himself to cheeses which can be made from small quantities of milk by the use of cheap apparatus. Further, as it would not pay the small holder to employ skilled labour, the process must be simple and such as any intelligent person can understand. There is at present an increased demand for such small cheeses, and there is no reason why a regular trade in them should not be created in our cities and large towns.

In developing a trade in small cheeses, description, size, and quality require to be standardised. The cheeses should conform to particular types, and be put upon the market regularly and in sufficient quantities.

The Midland and Southern districts of England are perhaps most favourably situated for producing soft unripened cheeses, for at present there is less demand for this class of cheese in the North and in Scotland.

It is important that all soft and fancy cheeses be packed neatly and put on the market before they are fully ripe, as they soon deteriorate and become unsaleable.

Two varieties of small pressed cheeses which should be ripened, and two soft varieties which should be sold fresh, are described below; all are suitable for those who have only a limited quantity of milk at their disposal, and all can be made by the average small holder or members of his family.

The Milk.

As with all methods of dairying, it is essential that the milk intended for cheese-making should be perfectly clean and in good condition (See Leaflet 151, *Cleanliness in the Dairy*). It is of no use attempting to make good cheeses with dirty or carelessly handled milk, or milk kept under insanitary conditions. Good flavour in cheese ensures a ready market at remunerative prices; poor flavour condemns it.

Buildings and Utensils.

Almost any clean, airy, and well-sheltered building having a good floor is suitable for cheese-making purposes, and if a cellar is available in which to ripen the pressed

cheeses, so much the better. If a dairy has to be built, it should be of brick, with a cement floor falling to a channel, which leads to a suitable gulley placed outside the dairy and communicating with a proper drain. If pressed and ripened cheeses are to be made, a similar building, to be used as a curing room, should be erected in line with the dairy, but sunk about 2 ft. in the ground, and provided with a floor of cement. A series of shelves, on which to place the cheeses, should be put round the ripening room, and the walls of both rooms should be limewashed at least twice each year. When not required for cheese, the making-room would do duty as a butter dairy. A suitable size for the making-room is 10 ft. by 8 ft., and for the ripening-room, 8 ft. by 8 ft. The roof may be of tiles, thatch, or galvanised sheeting lined underneath with boards. Perfect and ample ventilation in each room is necessary, and all ventilators and windows should be made to open and close as desired, so that the rooms can be kept at a suitable temperature. In order to save expense both rooms may be made of wood placed on three or four courses of brick to prevent rotting. If built of wood, the outside walls would need to be double, with an air space between. The making room should usually be kept at a temperature of 62° F. to 66° F., and the curing-room from 58° F. to 62° F.

The Utensils.—A table 6 ft. long by 2½ ft. wide, with raised sides and ends, and lined with tinned sheeting, is necessary. This table should slope to one corner, and be provided with an outlet and pipe to allow of proper drainage of the whey from the cheeses into a pail below. One or two well-made oak tubs in which to coagulate the milk are required; they should be of a capacity of 6 gallons each, and be provided with close-fitting wooden lids. The maker will need a large knife with which to cut the curd, a milk-strainer, curd-ladle, skimming-dish, and thermometer, as well as cheese-moulds, boards, straw mats, measures, cheese-draining rack, set of shelves on one side of the wall, measuring-glasses, pails, and brushes; also weights up to 28 lb. with which to press cheeses Nos. 1 and 2, and a supply of rennet extract. The measuring-glass, 1-oz. size, should be sub-divided into drams. The straws for making the mats should be of wheat or rye straw. The other articles are obtainable from firms supplying dairy utensils. With such an outfit all the four varieties of cheeses described below can be made.

Pressed Cheese No. 1.

This is a cheese similar to the French Port-du-Salut, and not unlike the Welsh Caerphilly. It is a little firmer in texture than the former, and is more quickly made, and requires fewer utensils and less accommodation than the latter.

Setting the Milk.—Five gallons of fresh sweet milk are required to make one cheese of standard size, and the circular cheese-moulds should be 10 in. in diameter by 4 in. deep, strongly made of tin, perforated all round, and provided with a close-fitting circular wooden disc or "follower." The milk is first raised to a temperature of 92° to 95° F., and rennet in the proportion of 1 dram to each 2 gallons is added to bring about coagulation. The rennet is diluted with water, carefully mixed with the milk, and the contents of the tub are stirred twice or thrice during the first four minutes. (It is well to remember that for all varieties of cheese it is necessary to dilute the rennet extract with about six times its volume of water before adding to the milk.) The tub is then covered with the wooden lid, and left for 30 to 35 minutes, when coagulation should be complete.

Cutting the Curd.—The curd—as the coagulated milk is called—is ready for cutting when it feels firm and springy, and splits with a clean fracture in front of a thermometer or finger drawn through it. A large knife, long enough to reach the bottom of the tub, is taken, and the curd is carefully cut into ½-in. sections. When cutting is completed, the curd is gently broken up with a skimming dish, and reduced as far as possible into ½-inch cubes. (Special cutters for reducing curd to cubes may be obtained.) After cutting, the curd is gently stirred by hand for from 10 to 15 minutes, and then allowed to settle in the whey.

Scalding the Curd.—A cheese cloth is next thrown over the tub and pressed down to the curd, a quantity of whey is ladled off into a pail, and the temperature of this is raised by immersion in hot water to such a degree that when it is poured back into the cheese tub the whole of the contents may have a temperature of 98° F. or 100° F. This process is generally known as "scalding" or "cooking" the curd.*

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* In order to estimate the temperature to which that portion of the whey removed should be heated, it is first necessary to ascertain the quantity of the coagulated milk in the tub, and its temperature. In this instance there are 5 gallons in the tub, and the ascertained temperature is, say, 90° F. It is required to raise the whole to 98° F.; therefore, each gallon of milk will have to be raised 8°. This, multiplied by 5—the total gallons of milk used—represents 40°. If two gallons of whey have been taken off, and the temperature is 90° F., to obtain the necessary degree of heat in the whole contents of the tub, these two gallons must be heated to 110°F., or, if one gallon only had been taken off, the temperature would need to be raised to 130° F. It is not, however, advisable to raise the temperature of whey to a higher degree than, say, 120° F., or the cheeses will suffer in quality.

The rule for scalding is as follows: Multiply the number of gallons in the tub by the number of degrees by which the milk has to be raised. Divide the number so obtained by the gallons of whey removed. The result added to the temperature of the whey when removed will be the temperature to which the whey must be heated before returning to the cheese tub.

When the curd has been scalded to 98° F. or 100° F., stirring continues for 20 to 30 minutes, or till the curd becomes tough and bright in appearance and sinks rapidly. On pressing a little in the hand, the particles should not break and should be a little springy. When this stage is reached, the curd is allowed to settle for 10 minutes, and the whey is then poured off through a straining cloth. Should the temperature have fallen considerably during the process of stirring, it is well to bring it up to the original scalding temperature before allowing the curd to settle.

Moulding and Pressing.—The curd is now ready for putting in the cheese hoop or mould. The hoop is placed on a flat board 1 ft. square and a cheese cloth placed inside; the curd is then lifted with the hands, broken up, and placed rapidly and evenly in the hoop. When filling is completed, the edges of the cloth are turned over, the wooden follower is placed in position and pressure is applied at once by means of a 14-lb. weight, which should be kept on for 15 minutes. The weight and follower are then removed, the edges of the cloth turned back, and the cheese turned by hand. Hoop, cloth, and follower are then replaced, and the cheese weighted up to 21 lb. In 30 minutes more the cheese is again turned, and weights up to 28 lb. are placed upon it. It is pressed thus for 4 hours, when the cloths and follower are removed, the edges of the cheese are trimmed, and it is then left uncovered in the hoop.

Salting and Ripening.—The next morning salting takes place, and this is done by rubbing 1¼ oz. of salt carefully all over the cheese, leaving a little extra salt on the upper surface. It is again turned and salted in the evening, and the following morning washed with 10 per cent. brine (1 lb. of salt per gallon of water), and placed on the shelf in the making room to dry. On the third day after making, it is taken to the curing-room or cellar and turned each day till ripe. It may be rubbed occasionally with a little brine to keep the skin clean. At the end of 3 weeks the cheese should be ready for use, but it will improve in quality if kept for six weeks. When ripe the cheese will weigh about 5½ lb., and should realise 8d. or 9d. per lb.

Note.—Should the cheese ferment and get out of shape during ripening then either the milk has been tainted, or the curd insufficiently scalded. On the other hand, should the cheese have a tendency to get hard and brittle, or the surface to crack, then the milk has been a little sour, or the process of filling into the hoops too long delayed.

Should a smaller cheese be required, hoops of a less diameter should be used, as, if the cheeses are to ripen properly, they must be at least 1½ in. thick.

Pressed Cheese No. 2.

This is a cheese made from mixed evening's and morning's milk, but the mixed milk should be fairly sweet. Five gallons will on an average make two cheeses of 2½ to 3 lb. each in weight. This cheese partakes somewhat of the flavour and texture of a Cheshire, but very little acidity is allowed to develop in the curd.

Setting the Milk.—The temperature of the milk is first raised to 90° F. or 92° F., and rennet is added in sufficient quantity to bring about perfect coagulation in 40 minutes. The amount of rennet necessary will be about 1 dram to each 2½ gallons of milk (see p. 3). After stirring for 3 or 4 minutes, the cheese tub is covered, and the milk left to coagulate.

Cutting the Curd.—When coagulation is complete, the curd is cut into squares about ¾ in. in size, and these squares are then cut diagonally across. In this state the curd is allowed to remain covered up for 15 minutes.

Draining the Curd.—A perforated skimming-dish is used to ladle out the curd in slices ½ in. thick. The curd is placed in a coarse cheese cloth laid over a wooden frame with a loose draining-rack beneath. The frames are about 2 ft. long by 18 in. wide, and 4 in. in height, and the whey escapes freely through the rack placed beneath. The curd should be ladled out quickly, and the temperature kept up as much as possible. When all the curd has been transferred, the edges of the cloth are brought over, and the whole covered with dry cheese cloths. The cloth should be opened out occasionally, and scraped with a blunt knife, spreading the curd to the full extent of the rack. It is important that the whey be drained away quickly, or the resulting cheese will be too soft.

Moulding and Pressing.—When the curd has drained to such an extent that there are 2 lb. of curd to each gallon of milk originally used, it is in a fit state for putting in the hoops, which are about 6 in. wide by 4 in. deep, and are provided with followers made of elm-wood. The curd should be placed in the hoops with the hands, and pressed firmly at the bottom and round the sides, the top being finished off smoothly. In moulding these cheeses, the hoop should stand on a piece of coarse cheese cloth. This assists in forming a good surface, but otherwise the hoops are not lined. As the curd is filled in, it should be carefully broken up, but not too finely, or drainage will be retarded.

When the hoops are filled, the cheeses are at once turned by inverting the cheese and the hoop at one operation—after placing a duplicate cheese cloth and board on the top of the hoops. The cheeses should be kept warm and turned occasionally for the first hour. They should then be pressed,

first with a 7-lb. weight, and later with a 14-lb. weight, the weights remaining on the cheeses till evening, when they are removed, and the cheeses are allowed to remain in the hoops overnight to develop acidity.

Salting and Ripening.—In the morning the hoops are removed, and the cheeses are carefully salted. A thick layer of salt is desirable, and the upper surface should be more heavily salted than the rest. In the evening the cheeses are again turned and salted, and remain in the hoops for another 12 hours. They are then placed in strong brine for 6 hours, and, when taken out, have a light muslin bandage pasted neatly round the sides. When dry on the surface they are taken to the ripening-room, turned each day, and will ripen in about 3 weeks. If the cheeses are required for use quickly, the first salting should be delayed. The temperature of the cheese room should be kept up to 62° F. or 65° F. during the whole process of making.

In hot weather it is advisable to spread a teaspoonful of salt in the centre when the hoops are half filled. The cheeses should have a smooth, clean coat, and be free from cracks, or there will be trouble with the cheese fly. If the coats are rough on removal from the brine, they should be scraped smooth with a knife before the sides are bandaged. Cheeses of this variety are quickly and easily made, and sell readily at from 7*d.* to 9*d.* per lb.

Soft Cheese No. 1.

This cheese is made somewhat after the style of the French Coulommier cheese, and is sold in an unripened state. It is made from whole milk, is circular in form, about 1½ in. deep, and weighs a little over 1 lb. One gallon of milk will make two cheeses, and the milk should be fresh and sweet.

Setting the Milk.—The renneting temperature varies between 82° F. and 86° F., and is regulated according to the temperature of the dairy, being raised if the room is cold, and lowered if warm. If the season is unusually cool, it is well to add a little sour milk or buttermilk before adding the rennet, as this will assist in after-drainage, and also prevent the formation of gas holes in the cheese.

About ½ dram of rennet diluted with water (see p. 3) should be added to each 2 gallons of milk, which should be stirred occasionally during the first half-hour to keep down the cream. If the cream be allowed to rise, it will show in unsightly streaks when the cheese is cut, but overstirring must be avoided, or there will be great loss of fat during drainage, and the cheese will be hard and dry. The tub should be carefully covered, and at the end of about 3 hours the curd should be ready to place in the moulds.

Moulding the Curd.—The circular moulds are of tin, 5¼ in. wide and about 5 in. deep, and made in two pieces. The lower half of the mould is about 3 in. in height. The moulds are placed in pairs on straw mats resting on draining-boards, the boards being 14 in. by 8 in., and of yellow pine ½ in. in thickness. The curd at ladling should be distinctly firm, and the whey clearly visible on the surface; if ladled out when too soft, the cheeses will not drain properly. The ladle is of tinned iron with a long handle, and about 4 in. across the bowl. The bowl should have a sharp cutting edge or the curd will be damaged and loss of fat ensue. The cheese-making room should be kept warm, and at the end of 3 or 4 hours the curd should have sunk into the lower half of the mould. When it reaches this stage the upper part of the mould or hoop is removed, a straw mat and a board are placed on the top of the moulds, and all are turned at one operation.

Salting.—The cheeses are salted when they will keep their shape on removal of the lower hoop. A little salt is first rubbed on the upper surface, and the cheese is later turned and held in the palm of the left hand and salted carefully all over, about 1 oz. of salt to each cheese being required. In two or three days the cheeses will be ready for use, and they are then wrapped in grease-proof paper, placed in chip or cardboard boxes, and sold. These cheeses realise from 6*d.* to 8*d.* each, and yield a good profit.

Note.—Should the cheeses drain slowly in the hoops and afterwards become fermented, either the temperature at renneting has been too low or the curd has not been sufficiently firm when ladled out. Tainted milk will also cause sponginess in the cheese, but this can usually be obviated by the addition of a little sour milk at renneting.

Soft Cheese No. 2.

Another soft cheese is made from fresh whole milk, and is usually designated Cambridge cheese. It is an English variety, and is in demand during warm weather, only being made during the summer months. It should not be made in large numbers at one time unless there is a ready sale for it, as, being unsalted and delicate, it quickly deteriorates, becoming yellow and unsightly in appearance.

Setting the Milk.—Two cheeses can be made from a little more than six quarts of milk. The temperature at renneting should be from 92° to 95° F. About ½ dram of rennet should be added to the quantity of milk mentioned, and the cheese tub should be carefully covered. It is advisable to use a smaller tub when making not more than four cheeses. The rennet should be diluted as described at p. 3 and be stirred in for 3 or 4 minutes.

Moulding the Curd.—When the curd is well set and firm, and the whey is on the surface, the curd may be removed with a skimming dish and placed in the moulds in thin slices, a portion of unbroken curd being set aside to form a smooth upper surface on the cheese. The moulds are in two pieces, the bottom portion holding a threaded straw mat, which prevents the curd escaping, while the upper one is pierced with draining holes. They are about 7½ in. long by 5 in. wide and 6 in. deep, and should be made of elm wood. Moulds made of tin should not be used, as in these the curd rapidly loses heat, and drainage is thereby retarded. With tin moulds the curd settles into a flat cake, but with wooden moulds the curd adheres to the sides, causing the cheese to settle in the middle first, thus producing a curl in the curd which adds greatly to the appearance of the cheese.

These cheeses are not turned at all, and are ready for sale when the wooden moulds can be removed without the cheeses losing shape, each cheese weighing well over a pound. They are consumed fresh, being sold along with the straw mat upon which they have been drained, the mat keeping the cheese in shape. They are sent to market in wooden boxes containing several trays, and a single layer of cheese is placed on each tray. They will realise from 8d. to 10d. each cheese.

Note.—A tough, leathery cheese is caused by too high a temperature or too quick drainage. On the other hand, if the cheeses are spongy or soft the temperature at renneting has probably not been high enough or the dairy has been too cold.

Whitehall Place, London, S.W.,
July, 1910.

Revised, November, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 232.

BOARD OF AGRICULTURE AND FISHERIES.

"Corky Scab" of Potatoes (*Spongospora scabies*, Mass.).

The parasite producing "corky scab" in potatoes, for many years considered as a fungus, is now known to be a member of the numerically small but cosmopolitan group of organisms known as the Myxogastres, which are still retained amongst Cryptogams, and either included in the fungi, or considered as a satellite of that group.

Most of the species are minute and the majority are saprophytic, or feed on dead organic matter. To this statement, however, there are two marked exceptions: *Plasmodiophora brassicæ*, Woronin, the cause of "club-root" or "finger-and-toe" in cruciferous plants (Leaflet No. 77), and *Spongospora scabies*, Mass., the parasite under consideration.

The parts of affected tubers which are not actually attacked by "corky scab." remain sound, but such tubers are nevertheless rendered unsaleable, and very considerable loss may result from the presence of this "Scab."

Geographical Distribution.

Spongospora scabies is abundant, and has caused a serious amount of damage, in Great Britain, Ireland, and Norway. It has been found in some quantity in Germany. It is highly probable that "corky scab" may be present in greater or less quantity wherever the potato is cultivated, and that it has been passed over as "scab" without any attempt to discriminate between the various forms of "scab."

Appearance of Diseased Potatoes.

"Scab" is the popular term covering the general appearance of diseased tubers, but, unfortunately the name "scab" is applied by the potato grower to several diseases which differ very materially in origin. One form of scab, very prevalent on potatoes grown in the neighbourhood of towns, is induced by the physical action of ashes on the growing tubers where night-soil mixed with ashes is used as manure. A second form is due to the attacks of eelworms on the

surface of the tuber, while a third type is caused by the millipede *Julus pulchellus* (Leaflet No. 94). American scab is caused by *Oospora scabies*, Thaxt., a much reduced type of fungal life (Leaflet No. 137). All the above forms of scab show a close superficial resemblance; the surface of the tuber is more or less covered with quite shallow wounds, round the margins of which a copious formation of corky tissues is developed, and a rugged or scabbed appearance is produced. The disease known as "Black Scab," or more properly "Wart Disease" of potatoes, is entirely distinct from the above kinds of scab, and does not resemble them in appearance (Leaflet No. 105).

The scab induced by *Spongospora scabies* has received the appropriate name of "corky scab" on account of the considerable development of wound-cork around the injured portions. In the early stage of the disease small, dark-coloured, and slightly raised patches appear on the surface of the tuber; these, however, are not as a rule uniformly scattered over the entire surface, as in the forms of scab indicated above, but are more or less localised. When the vegetative phase has been completed and the formation of the spores has commenced, the skin of the raised blister is ruptured, and a dense mass of brownish or snuff-coloured spore-balls is exposed.

The further extension of the disease on a given tuber depends mainly on the relative abundance of moisture present in the soil, as has been proved by experiments made at Kew with diseased tubers submitted for investigation. When potatoes showing the disease in the stage indicated above are placed in comparatively dry soil, wound-cork is quickly formed immediately below the seat of injury, and the further development of the parasite is arrested. On the other hand, if slightly attacked tubers are placed in soil that is kept constantly wet, the formation of wound-cork is arrested, and the continuous development of the parasite is favoured in proportion. Large cavities from half an inch to an inch deep are thus formed owing to the vegetative portion of the parasite continually eating into the substance of the tuber, and the cavity so produced becomes filled with a dense powdery mass of spore-balls.

The presence of such masses of spore-balls suggests *Spongospora scabies*, but, as in the case of every kind of scab, microscopic examination is necessary to ensure a correct determination of the specific nature of the disease.

Owing to the absence of a mycelium, those portions of a tuber not actually attacked by the parasite remain perfectly sound, and hence partially diseased potatoes, which are unsaleable, are frequently reserved for "sets." This is a

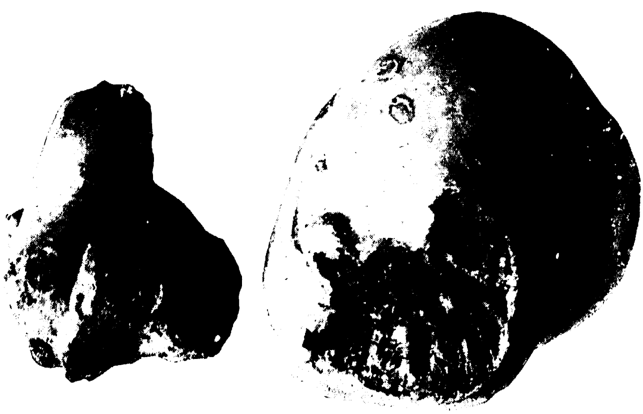
dangerous practice, as the parasite in what is known as the *plasmodium* condition can remain in a passive state until the tuber commences to sprout, when it may resume active growth and so perpetuate the disease.

The spore-balls produced in the cavities of the tubers represent the ultimate phase of development of the parasite, and may be considered as equivalent to the resting-spores in the fungi. They become liberated by the decay of the cells of the tuber in which they were originally formed, and may remain in the soil in a passive condition until the following season.

It has been definitely proved that the application of lime prevents the disease known as "Club-root" or "Finger-and-Toe" in turnips and other cruciferous plants, and as the organism causing "Corky Scab" is very closely allied to the club-root parasite, it was thought that lime might prove to be a check for this disease also. Recent experiments in the West of Ireland, however, appear to show that lime, instead of checking *Spongospora* scab, actually favours its development.

Preventive Measures.

1.—It is certain that the parasite remains in a diseased tuber in a passive state when conditions are unfavourable for active vegetative growth. Diseased tubers, therefore



SCAB DUE TO *Spongospora scabies*, Mass.

should not be used for "sets," as the commencement of activity on the part of the parasite is regulated by the commencement of growth on the part of the potato, and a scabbed

crop will probably result, in addition to the risk of infecting previously clean land, if diseased sets be employed.

2.—The parasite located in the superficial cells of the potato is killed by soaking diseased potatoes for two hours in a solution of half-a-pint of formalin in 15 gallons of water. It is very doubtful, however, whether a *plasmodium* lying somewhat deep in the tissue of the potato would be affected by this treatment. Under any circumstances it is a very risky and unwise practice to plant diseased "sets."

3.—It is probable that clean potatoes that have been in contact with diseased ones, may give rise to an infected crop by means of loose spore-balls adhering to their surface. Not only, therefore, should sound tubers be used for planting, but care should be taken that they do not come into contact with diseased ones.

A full description of "Corky Scab" with an illustrated account of the life-history of *Spongospora scabies* was given in the *Journal of the Board of Agriculture*, November, 1908, p. 590.

Whitehall Place, London, S.W.,
September, 1910.

Leaflet No. 233.

BOARD OF AGRICULTURE AND FISHERIES.

Actinomycosis or Hard Tongue in Cattle.

This disease is met with in most parts of Great Britain under such popular names as Hard Tongue, Wooden Tongue, Wens, Lumpy Jaw, Big Head, &c. In this country cattle are principally attacked, but the disease may also occur in pigs, sheep, horses or man.

Actinomycosis runs a chronic course and is characterised by the formation of tumours in various parts of the animal body. These tumours interfere with the functions of the organs in which they are situated and usually burst or ulcerate. If untreated the animal steadily wastes away, especially if the tongue be affected, and it eventually dies.

Cause.

The disease is caused by the entrance into the animal, and the propagation in its tissues, of the parasitic fungus *Actinomyces*. This fungus grows on grasses and most cereals, particularly on barley, flourishing luxuriantly on damp rich soils. Injuries to the skin and to the mucous membranes of the mouth and tongue, caused by hard straws or barley awns, as well as the teething troubles of young animals, predispose cattle to this disease by favouring the entrance of the *Actinomyces* to the tissues.

Symptoms.

The disease is usually local or confined to one organ of the body, and the symptoms are largely determined by the part attacked. Nodules of varying sizes often form on the skin of the head and neck, at times being firm to the touch, while sometimes the skin is broken and the nodules are granular, soft, yellowish in colour, and covered by a crust. The skin covering the lips, being very liable to injury, is frequently attacked, the lips then becoming hard and enlarged to such an extent that food is gathered with difficulty.

The tongue, however, is the most common seat of the disease. The presence of the *Actinomyces* in this organ excites a growth of fibrous tissues, causing the tongue to become hard and immobile, hence the name "wooden tongue." This gives rise to a constant dribbling of saliva and quidding of the food, which causes the mouth to be examined. The hardness and painfulness of the tongue and the presence of ulcers at its base, render this form of the disease easy of diagnosis.

Tumours can sometimes be felt under the skin in the muscles of the cheeks. The jaw bones, usually the lower, may be invaded by the *Actinomyces* from the soft tissues of the mouth and possibly through the sockets of the teeth. Great swelling of the attacked bone is noticed, and the head sometimes swells to a great size. Pus collects in cavities in the bone, eventually breaking through the skin, and forming wounds which constantly discharge. In this condition the jaw is easily fractured and the teeth drop out.

A very common form is met with when the glands of the neck are affected—a swelling or "wen" appears between the angles of the jaw, which steadily increases in size until breathing and swallowing are interfered with. These tumours often burst and discharge a characteristic, granular, yellow pus.

The presence of tumours (*polypi*) attached to the mucous membrane of the mouth and the back of the throat can often be recognised by the snoring grunt which accompanies breathing, and by the difficulty in swallowing.

Actinomycosis also occurs in the udder, and in the spermatic cord of castrated animals, giving rise in each case to fibrous enlargement of the organs.

The Board ascertained in 1907 that the number of animals affected on different farms in Norfolk, where the disease causes much trouble, varies from 2 to 30 per cent. of the cattle kept.

Treatment.

In districts where the *Actinomyces* flourishes it is almost impossible to prevent animals being attacked.

1.—Drainage of land is said to have diminished the number of cases by checking the growth of the fungus.

2.—If barley straw must be fed to stock, it should not be given to young animals when changing their teeth, as the fungus then has an excellent opportunity of entering the tissues through the gums.

3.—Although prevention is difficult, the disease responds to treatment. Whenever possible, the tumours caused by the disease should be removed by a veterinary surgeon. When their position renders an operation impossible, medicinal treatment will generally check or cure the disease. Treatment should only be attempted by a skilled surgeon, as the tumours have usually to be removed from the region of the head and throat, while the success of the medicinal treatment depends on giving iodide of potassium under expert supervision until symptoms of poisoning by this drug appear, when its administration must immediately be stopped. Affected animals should be isolated during treatment.

4.—No evidence is forthcoming that the disease has ever been established on a hitherto clean farm by the importation of infected animals; nevertheless, it is not advisable to introduce a diseased animal among a clean herd.

5.—Farmers who have cattle suffering from this disease should consult a veterinary surgeon.

Whitehall Place, London, S.W.,
July, 1911.

Leaflet No. 234.

BOARD OF AGRICULTURE AND FISHERIES.

Botrytis Diseases.

Parasitic fungi often limit their attacks to a few kinds of closely allied plants only, but the fungus *Botrytis cinerea* is a marked exception to this rule, as it injures many plants belonging to widely separated families. In fact, under favourable conditions, such as an excess of moisture and a high temperature, all classes of plants are liable to be attacked. As a saprophyte (*i.e.*, a fungus which lives on *dead* organic matter) *Botrytis* is often to be found on decaying vegetable matter and the spores produced in this way readily infect living plants.

The three forms of *Botrytis* disease described in this leaflet are well-known and occur frequently. As the symptoms and methods of treatment differ in each case each form has been dealt with separately. Advice as to general treatment in connection with other plants is given at the end of the leaflet.

1. Botrytis Disease of Potato.

Description.

The most obvious sign of an attack by *Botrytis* is the presence in late summer or autumn of dead, white stems, more or less studded with small, flat, black bodies termed sclerotia (Fig. 1). These bodies serve to tide the fungus over the winter season, and they give rise in spring to a crop of spores which are capable of infecting the potato foliage. The tubers are not infected, the disease being confined to the leaves and stems.

A *Botrytis* attack takes the following course. The potato plant is usually infected by spores germinating upon old yellow leaves, though in prolonged spells of warm, damp weather direct infection of young healthy foliage also occurs. The disease shows itself first as brown, dead areas usually at the tips of the leaflets. The mycelium (or vegetative thread-like growth) of the fungus rapidly destroys the tissues, and, growing through the leaf-stalk, enters the stem, whence it proceeds in a downward direction killing the outer tissues, and involving also the loss of other leaves.

In many cases the attack is slight and only a small portion of the stem and a few leaves are affected, but with continued wet weather it is more severe and the whole of the shoot dies and turns brown. A greyish mould develops on the surface of diseased leaves and especially on those which fall off or are near the ground. The mould represents the fruiting stage of the *Botrytis* fungus and consists of myriads of spores (conidia) borne in minute heads. These spores are dispersed by wind and rain, and, germinating at once, rapidly spread the disease. The heads of spores resemble those found in the conifer disease (Fig. 5).

After the spore-phase the fungus forms sclerotia which, later in the season, appear conspicuously on the dead, blanched stems. The sclerotia, which consist of compact masses of mycelium, germinate in spring and produce *Botrytis* fructifications precisely similar to those found on the leaves and stems in the summer.* The spores from these fructifications give rise to mycelium which ordinarily lives as a saprophyte on decaying vegetable matter, but, under conditions of abundant moisture and warmth, readily becomes parasitic and attacks the living potato foliage.

Treatment.

As *Botrytis cinerea* confines its attacks to the haulm, treatment should be directed to reducing the amount of leaf infection. Varieties which are resistant to ordinary Blight have been found resistant also to *Botrytis*, hence in districts where these diseases are frequent such varieties should always be selected. In order to lessen the chances of re-infection in spring, old diseased stems bearing sclerotia should be collected and burned before the crop is lifted. Spraying for the control of *Botrytis* has so far not been successful.

2. Leaf-shedding in Conifers, due to *Botrytis*.

This disease is well known both in this country and on the Continent. It has been recorded as attacking the following trees:—Douglas Fir (*Pseudotsuga Douglasii*), Silver Fir (*Abies pectinata*), Spruce (*Picea excelsa*), Larch (*Larix europaea*), Wellingtonia (*Sequoia gigantea*). It has also been observed on Junipers, while the Scots Pine (*Pinus silvestris*) has been infected artificially with spores obtained

* These sclerotia have, in the past, been confounded with those of *Sclerotinia sclerotiorum*, another potato parasite, but the two fungi, though sometimes found together, are as explained fully in Leaflet No. 127 (*Sclerotinia Diseases*) quite distinct.

from a diseased larch. Young nursery stock suffers most, but the youngest shoots of very old trees are also attacked.

The first indication of disease is a yellowing of the leaves, which finally turn brown and die, but are frequently

FIG. 1.—Portions of dead potato stems which have been attacked by *Botrytis cinerea*. The sclerotia of the fungus show as small black flattened-bodies closely attached to the stems (nat. size).

prevented from falling, by being held in a tuft by a delicate weft of brown cobweb-like mycelium. The affected shoots are usually variously twisted or curved downwards.

Infection is due to spores conveyed by wind or insects. The uppermost shoots are most frequently attacked; in other cases, the lower part of the stem from the ground-line for two or three inches upwards, is infected, and the upper branches remain free from injury.

Leaves and shoots attacked by the disease eventually fall to the ground, where they remain until the following spring. In the meantime the mycelium of the fungus present in the tissues has given rise to numerous minute black sclerotia or compact masses of mycelium, which are more or less buried in the dead tissues. At the time when the young pine leaves are appearing, these sclerotia produce myriads of spores, which are distributed by various agents, and infection results.

The spores are capable of directly infecting young leaves, the germ-tube piercing the epidermis, whereas the bark of a two-year-old seedling can only be entered by a wound caused by late frost, punctures of insects, or other agencies.

Treatment.

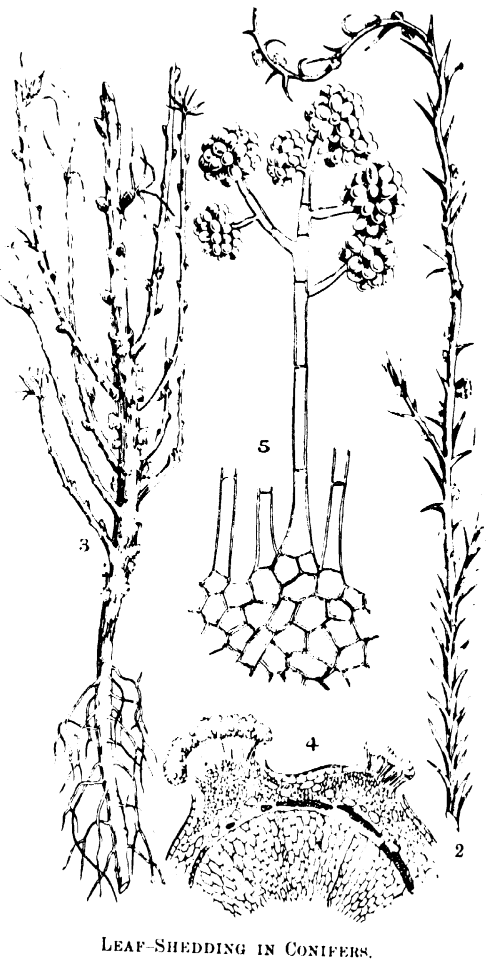
1.—Perfect cleanliness in the seed-bed is of primary importance. Weeds should not be hoed up and left to die on the ground in the spring, as *Botrytis* grows on all kinds of dying and dead plants, and the spores pass on to the leaves of the seedlings.

2.—Stable manure should not be used, as the fungus causing the disease is known to spread from manure, which is imperfectly buried in the soil. The projecting portions of straw are at times thickly covered with the *Botrytis*.

3.—The fungus is dependent on moisture, and only produces spores in a humid atmosphere, hence it is important that damp, low-lying situations should be avoided for nursery purposes.

4.—When the disease is present, spraying with the following solution will check its progress :—

Copper sulphate (98 per cent.) ...	2 lb.
Washing soda (pure)...	2½ lb.
Water	10 gal.



LEAF-SHEDDING IN CONIFERS.

DESCRIPTION OF THE FIGURES.

2. Terminal shoot of a Wellingtonia seedling killed by *Botrytis*. Clusters of the fungus in a fruiting condition are springing from the dead portion of the shoot. Two-thirds nat. size.
3. A larch seedling showing stem disease. Numerous tufts of the fungus are attached to the lower portion of the stem. Two-thirds nat. size.
4. Transverse section through a portion of the stem of a diseased larch seedling. The cortex is seen to be broken up by the mycelium of the *Botrytis*, which has formed two sclerotia that have burst through the bark, and are bearing spores. Mag. about 33 diam.
5. Portion of a sclerotium producing clusters of spores. Mag. 266 diam.

To prepare the mixture the copper sulphate should be dissolved in 9 gallons of water in a wooden vessel and the washing soda in 1 gallon of water. The soda solution is then poured into the copper sulphate solution, stirring continuously.

5.—All diseased seedlings should be collected and burned.

3. The Botrytis Disease of the Gooseberry, or "Die-back."

The *Botrytis* disease of the gooseberry—or "die-back," as it is called in some districts in Kent—is wide-spread in England, and is liable to occur wherever gooseberries are grown, whether in plantations or in private gardens. It attacks bushes growing on stiffish clay as well as bushes growing on light, gravelly or stony soils.

Description of the Disease.

The gooseberry bush may be attacked in four distinct places, viz., the main stem and base of the branches, the young wood of the current year, the leaf, or the berry. As regards the main stem, the mycelium (spawn) of the fungus penetrates the outer tissues, and at the end of a season's growth causes the bark to crack, and peel off, often in large pieces. The part of the stem first attacked is usually that portion situated at the ground level or a little above it; eventually the spawn of the fungus "rings" the stem at this place and the whole bush is killed. Before this occurs, however—and, in the case of a well-grown bush, death does not result as a rule for several seasons—the mycelium of the fungus spreads upward in the stem to the base of the branches. Here it frequently attacks some of the branches so severely that they die. The presence of dead branches in a few bushes, or the death of half the bush, is a characteristic sign of the first appearance of the *Botrytis* disease in a plantation.

Renewed growth of the mycelium of the fungus in the stem takes place every spring, and it is then that the manner in which the fungus exists and spreads can be most easily seen. If a diseased stem be examined during a warm and damp spell of weather in the spring, the appearance shown in Fig. 6 will be observed. The bark will be found to be peeling or cracking off, while greyish, fluffy patches of

a "mould" have appeared at the edges of the peeling bark or in the fissures where the bark is cracked.

If there is a dead branch on the bush, as a rule, small greyish tufts or little cushions—which soon develop in suitable weather into fluffy patches such as are shown in Fig. 6—will be found scattered here and there over its surface, as shown at x in Fig. 7. These tufts of the fungus occur both on the main branches nearly down to their base (*see* Fig. 7), and frequently also on the younger wood.

Small hard, blackish bodies, of irregular shape, named *sclerotia* are also produced. They are extremely resistant to climatic conditions such as frost, drought, etc., and serve to carry the fungus through all vicissitudes from one growing season to the next.

If an affected bush has been weakened by the *Botrytis* disease in previous seasons, the renewed growth of the fungus during the spring will frequently cause the death of the bush. In the affected plantation gooseberry bushes here and there and in all stages of growth may suddenly wilt and die; this occurs most frequently at the time when the leaf-buds have just burst open, but often also at a later stage when the bush is in full flower or bearing young berries. If such bushes are examined the stem will be found to be "ringed" by the spawn of the fungus, and on the surface of the stem will be found the *Botrytis* fructification as shown in Fig. 6. If the disease has not developed to a sufficient extent to kill the bush, the spores which are continually being produced throughout the spring and early summer serve to spread the disease to other parts of the bush.

Very commonly the spores infect the leaves, which soon become discoloured at their edges, at first turning yellowish, and finally ashy-grey or whitish (*see* Fig. 8). If the attack extends from the edge of the leaf inwards until the greater part of the leaf is affected (Fig. 9), the fall of the leaf soon takes place; if, however, as is often the case, the injury remains restricted to the edges of the leaves, they remain on the bush until they drop in the normal way. Whether the injury spreads over the leaf to such an extent as to make it fall prematurely seems to depend on the climatic conditions which prevail at the time. When a large number of leaves are attacked throughout a plantation and made to fall prematurely, serious damage is often inflicted; in such cases the berries produced are much smaller than on healthy bushes, and a quantity of unripened spindly shoots may be

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FIG. 6.—Portion of stem (just above ground level) of a gooseberry bush attacked by *Botrytis*; fructifications of the fungus can be seen appearing between the cracks of the bark.

FIG. 7.—Part of an old diseased branch; compact cushion-like tufts of *Botrytis* (x) have been formed on its surface.

formed. The under-surface of the leaf is the part attacked, and during the months of June and July the *Botrytis* fructification may be found on leaves which show the appearance represented in Figs. 8 and 9.

Another part of the bush which may be attacked is the young wood. In the case of young bushes especially, a considerable proportion of the young shoots may be affected and much weakened or killed (*see* Fig. 9)—a fact which has caused growers to speak of the disease as "die-back." The dead shoots may constitute a prolific source of infection. Prunings of *Botrytis*-affected bushes left lying in a heap in a corner of the plantation or garden may develop during the following spring an abundant crop of powdery tufts of *Botrytis*, the spores of which, carried by the wind in countless numbers, will spread the disease through the plantation. There is also the danger of cuttings having been taken from *Botrytis*-infected bushes, when many of the young bushes resulting therefrom will become diseased.

FIG. 8.—Shoot of "Whinham's Industry," with the leaves attacked at the edges by *Botrytis*.

Lastly, the fungus occasionally attacks the berry and causes it to rot. The first sign of disease on the berry is the browning of the skin at some spot; this browning gradually extends until one side of the berry shows obvious signs of softening and of being badly diseased. The

Botrytis fructification, in the form of the characteristic ashy-grey "mould," then appears on the surface of the

FIG. 9.—Two shoots of "Whinham's Industry," showing the leaves affected more severely, and a young shoot (*to right*) killed by the fungus.

discoloured portions, and the berry in about a week is completely rotten.

Treatment.

1.—The most effective method of treatment is to remove and burn promptly all dead bushes or branches in the plantation. As soon as the edges of the leaves become discoloured (*see* Fig. 8), the bushes in the plantation generally should be examined and any found with the main stem diseased should be grubbed up and burned. This treatment, carried out for a few seasons, has proved more efficacious than spraying. It must not be forgotten that the fungus is capable of developing vigorously on *dead* parts of the bush. In nearly all cases—except in

the comparatively rare ones where a plantation has been planted with *Botrytis*-infested bushes—the disease appears first either on single plants scattered here and there through the plantation, or on several bushes over a small patch of ground, while the surrounding bushes are healthy. If the disease on its first appearance is dealt with summarily by the burning of all dead bushes and branches, there is no need to spray or to take any other remedial measure.

2.—Where the disease is severe and widespread, or where the source of infection is beyond the control of the grower, spraying must be resorted to—in addition, of course, to the prompt burning of all dead bushes. A heavy spraying with a solution of copper sulphate (4 lb. dissolved in 100 gallons of water) should be given *just before the buds burst*, with the object of destroying the tufts of *Botrytis* (*see* Figs. 6 and 7), care being taken to spray thoroughly the main stems of the bushes. The infection or premature falling off of the leaves may be prevented by spraying, *directly the fruit is set*, with Bordeaux mixture composed of 8 lb. copper sulphate, 8 lb. quicklime, and 100 gallons of water (for the preparation of this mixture, *see* Leaflet No. 23, *Potato Disease*). It is essential that the under-surface of the leaves should be reached as much as possible. No injury follows the application of Bordeaux mixture of this strength, and if the spraying be done at the time indicated, no spotting of the berries occurs.

3.—It may finally be noted that any treatment which induces the bushes to make vigorous growth tends to stop the attacks of the fungus.

General Treatment for Other Plants.

In addition to the above many other plants are injured by *Botrytis cinerea* or allied species, for instance Lettuce, Cyclamen, Primula, Paeony, Lily of the Valley, various bulbs such as Tulip, Onion, and Snowdrop; Beet, Swede, Turnip, and Mangold (in clamp); also *Ribes*, *Vitis*, and other woody plants.

The following suggestions may be given for preventing an attack :—

1. As the fungus thrives best under damp and shady conditions overcrowding should be avoided and weeds kept down.

2. *Botrytis* is found upon the decaying leaves and stems of all kinds of plants, and these act as a nursery for its growth and dissemination. Garden refuse should, therefore, be collected and burned.

3. All infected leaves and stems should be cut off and burned. Diseased tubers and bulbs should also be carefully removed from the soil and destroyed.

4. Lime has been found of little value for destroying the fungus in the soil, but the disease is less frequent in soils well provided with lime.

5. In storing roots diseased and injured specimens should be rejected and bruising should be avoided as far as possible. The pits or clamps should be well drained and freely ventilated.

6. When there has been an attack of *Botrytis* disease the same crop should not be grown on the ground until a period of one or two years has elapsed.

Whitehall Place, London, S.W.,
January, 1905.
Revised, March, 1917.

Leaflet No. 235.

BOARD OF AGRICULTURE AND FISHERIES.

The Organisation of the Milk Supply.

Co-operation between farmers for the disposal of their milk may lead to improvement in the purity and regularity of the supplies, to a better price being obtained by the producer, and to the removal of difficulties in connection with the disposal of surplus milk. Co-operation should prove of advantage not only to the farmers themselves. but also, from the point of view of the improvement of purity, to the general public as consumers.

Purity.—The purity of milk as it reaches the consumer is likely to be improved by the organisation of the producers, since it is to be expected that the milk will receive more effective treatment for the removal of impurities at the common collecting centre than on individual farms; and, further, clean methods on the farm are much more likely to be adopted under a co-operative system, since members must conform to the society's regulations.

Disposal of Surplus Milk.—Co-operation should facilitate the disposal of the surplus milk, which could be converted into cheese, cream or other milk products at the collecting depôt, and it has been found profitable in some cases to establish a central depôt, solely, or almost solely, for the disposal of surplus milk.

Some societies, for example, make cheese with great success. One society collects cream and makes it into butter at a central creamery. A Welsh society has adopted a system of butter blending as an alternative to making butter; the farmers make the butter themselves and send it unsalted to the premises of the society, where it is blended by an up-to-date plant. Another society converts its surplus milk into cream and separated dried milk powder.

The central depôt is much more likely to be able to secure efficient marketing than the individual farmers. Among other advantages the produce could be graded and standardized, and public attention could be attracted and its confidence retained by efficient advertising and the use of names and brands.

The Collecting Depôt.—The first step to be taken by dairy farmers who have agreed to combine to dispose of their milk, is the establishment, preferably at or near a railway station, of a milk *collecting depôt*, equipped with a refrigerating plant and cold store, as well as with the necessary plant and utensils for the manufacture of cheese, butter, and other forms of milk products. The provision of an ample supply of pure cold water is essential for refrigerating purposes. The milk of the district would be brought to this depôt, and, after being tested and thoroughly refrigerated, cleansed and pasteurised, it would be dispatched by rail or motor to

the retail depôts or shops in the large centres of population, as well as to public institutions, hotels and restaurants.

Creameries or depôts may cost from £1,500 to £10,000 to erect and equip, but no hard and fast rules can be laid down, either as regards the plan on which the depôt is to be erected and equipped or the formation of a society, since due allowance will have to be made for the varying conditions in different districts. In one centre the primary object may be a milk depôt for the treatment and distribution of milk, with a plant sufficient to deal with the manufacture of the surplus into cheese; at another centre the business may be partly a milk trade and partly the manufacture of milk products; while in some districts milk selling will be quite out of the question, and cheese-making in summer and butter-making in winter will be advisable.

Capital and Business Management Necessary.—It must be borne in mind that a society should not commence to trade until adequate capital has been provided to start and carry on its business, and that a society cannot hope to succeed unless it is controlled by business men and is in a position to employ a competent manager and staff.

The capital of some of the largest societies in this country ranges from about £2,500 upwards, and the turnover from about £20,000 upwards.

Some of these societies have adopted a principle which it is very desirable should be extended, not only in co-operative milk-selling but in other forms of agricultural co-operation, viz., *trading with industrial co-operative societies.* As an example, one society, in addition to trading with ordinary retailers, and disposing of nearly 1,000 gallons daily to public institutions, sells about 2,000 gallons of milk daily to an Industrial Co-operative Society.

By-laws.—To carry out a scheme for the organisation of the milk supply on a proper basis, by-laws would have to be drawn up, regulating the conditions under which the milk should be produced and dealt with before it reaches the depôt. Many of the co-operative dairy societies affiliated to the Agricultural Organisation Society have drawn up such by-laws. The societies are registered under the Industrial and Provident Societies Act, 1893, and have in most cases adopted the model rules of the Agricultural Organisation Society. Model rules for co-operative dairy societies may be obtained from the Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, S.W., who will be pleased also to supply further information as to co-operation in the dairying industry, and to assist with advice in the formation of co-operative societies.

Whitehall Place, London, S.W.,
June, 1911.
Re-written, October, 1915.

BOARD OF AGRICULTURE AND FISHERIES.

Thatching.

The art of thatching can be learnt by any intelligent farm labourer, if he is given a little instruction and a few opportunities for practice. Farm hands frequently possess a natural aptitude for work of this kind, and an industrious man will soon become proficient.

It is a great advantage to a farmer to have men in his employment who can undertake ordinary thatching. After harvest the local thatcher is often hard-pressed with work, so that it may be difficult to obtain his services when they are most required. Meanwhile the unthatched ricks are exposed to the weather, and, should a wet season be experienced, the damage may be considerable. All risk of this sort is avoided if the thatching can be done by the regular staff, and farmers should, therefore, encourage their men to make themselves proficient in the process.

How to Learn Thatching.

A thorough knowledge of thatching, like that of any other branch of farm husbandry, cannot be gained without careful observation and frequent practice, but the beginner can commence by thatching straw ricks and thus acquire the skill necessary for the more important work of thatching corn and hay ricks.

Outfit and Materials.

The thatcher's outfit is neither a large nor an expensive one ; it consists of a bill-hook, a paring knife and a pair of sheep shears for trimming the eaves, a large "thatching fork" to hold the drawn straw or "yealms," and a wooden hand-rake with iron teeth.

Other articles necessary for thatching are a ladder sufficiently long to reach the ridge of the stack when laid perfectly level with the roof, a quantity of pegs, binding cord or oakum, a suitable wooden mallet or other implement to drive in the pegs (a flat leather attached to the wrist, and covering the palm when pressing the pegs home, serves the same purpose), and a running noose to convey the yealms of straw to the thatcher.

The principal materials used for thatching purposes are straw, reeds, and heather, according to the purpose for which they are intended. Oat and barley straw are only

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serviceable where the corn to be covered has not to remain in the rick for any considerable length of time; well-grown stiff wheat straw will answer all general purposes on the farm, but for more lasting purposes, rye straw and reeds are to be preferred, heather being mostly used for ornamental thatching—as, for example, model dairies, cricket pavilions, and summer houses.

Preparation of the Straw.

The preparation of the straw is of importance. Straw of a dry, loose character cannot be packed so tightly and securely as damp straw; for this reason the straw should be well douched with water and turned over with a fork until it becomes thoroughly moistened. The heap must then be slightly compressed by beating with the fork or treading. This has the effect of ridding the straw of flag and shack, the presence of which tends to arrest the flow of water.

Yealming.

The straw should next be drawn from the bottom of the heap where the pressure is greatest. The usual method is to grasp as much straw as can be gripped by both hands, the two being held close together. The straw is then drawn out by a quick movement of the arms towards the right, followed by a swing over to the left, finally laying it at the worker's feet, the thickest end being to his right-hand side. The work of yealming is usually undertaken by the thatcher's assistant or server.

When a sufficient quantity of this partially straight straw has been collected, the yealmer works through it, using his fingers to regulate it and to remove any loose portions, at the same time drawing the bundle closer to his feet, until the layer amounts to as much as he can hold in the grip of both hands. A "yealm" thus formed should never be broken, but kept firm and secure until placed on the stack. As the yealms are completed, they are placed crosswise on a short rope or cord, the thick and the thin ends alternating. When of sufficient number and weight for a man to carry, the rope, which should have a running noose, is drawn round the yealms, which are in this way conveyed to the rick.

A common practice in the South of England is to place the drawn straw direct in the "thatching fork," which, when fully charged, is carried to the rick, and the straw so conveyed to the thatcher. Other thatchers draw the straw dry and lay it on a board, after which it is damped, trimmed, and straightened out, being finally separated into yealms which are bound up in straw ropes.

Preparation of Stack.

In commencing to thatch a rick, the thatcher first prepares it by filling up any hollows with loose straw and levelling down humps in the roof in order to secure a firm, even surface. As the rick will probably have settled down, the top may require bolstering up with a "dummy," or tight-tied bundle of straw. When the roof has, in this way, been made firm and even, the straw can be laid on.

Perhaps the most opportune time for commencing the work is when the weather is somewhat damp, for the straw is none the worse for being slightly wetted. Under such conditions, also, the work of carrying in the corn is generally at a standstill, and there is ample leisure to complete the thatching of ricks which have already been erected. Very wet weather, however, is quite unsuitable, as the topmost sheaves would then be covered up while still wet with rain. Windy, gusty weather is also unsuitable for thatching as the thatch is being constantly disturbed and ruffled up.

How to Commence Thatching.

The ladder should be placed so that it lies flat on the rick; the work should then commence at the bottom, or eaves, the straw being meanwhile packed as firmly and securely as possible. When the top is reached, the straw is laid well up to form a point, thus affording a good pitch for the water to run off. In general practice, the eave-line of the stack is laid with a double thickness of straw, in order to provide a projecting eave which will shoot the water off the stack without injuring the sides. The actual operation of laying the yealms of straw upon the stack is quite simple, and very much resembles the slating of a roof. It is important to insert the thin end of each yealm under the roof of the stack; this makes it doubly secure, and ensures an even and permanent thatch. The pegs which are driven in the thatch should be inserted in a horizontal direction, not vertically; in the latter case they easily convey water into the interior of the stack, which naturally has an injurious effect. When laying the yealms alternately, one overlapping the other, the expert thatcher will keep them damp by sprinkling with water, meanwhile combing the straw with a thatcher's rake to make it lie perfectly even; he will then beat it down lightly but firmly so as to consolidate the whole roof into a regular thatch of uniform thickness throughout.

A medium coating of straw well laid invariably throws off water much better than a larger quantity of straw badly placed together. It is customary to commence thatching hipped-end stacks about the centre of one side, in order to

ensure a good finish; gable-end stacks are usually commenced at one end. The width of stack capable of being covered without moving the ladder will depend on the thatcher's reach, but this must not be exceeded beyond comfort, for when the thatch has to be packed in at arm's length it can never be done so firmly and securely as when a shorter stretch is taken.

Pegging and Cording.

To keep the thatch in position, pegs made of split hazel, willow, oak, or other tough wood are used. These pegs should be cut into lengths of from two to three feet, with the ends pointed. Any knots must be shaved off so that the pegs may be pushed easily into the stack. Split hazel rods are often made to take the place of cord between pegs, an arrangement which certainly has a very ornamental appearance; for general purposes, however, oakum or binding cord is used. As the work of laying the yealms proceeds the pegs should be inserted in a horizontal direction, and the cord secured thereto. The elaborate roping or cording of ricks is not practised so extensively at the present day as it was some years ago; few farmers keep their grain in the ricks for more than two years, while with the majority under twelve months is usual. If thatching is done with good, well-drawn wheat straw, well packed upon the roof of the rick, there will be no need for the elaborate methods of pegging so frequently seen in some districts. Thatching needs to be done very thoroughly in exposed parts of the country, especially in Scotland and in high-lying farms near the coast.

Trimming the Eaves.

The overhanging eaves of the stack must be pared or trimmed off. This is done by means of the paring knife, the sheep shears being subsequently used in order to trim off any rough edges and projecting straws, and to impart a smart "finished" appearance to the stack. The greatest importance is attached to the trimming off of the eaves: if this is well done, the under-surface of the eave will present a horizontal or even a slightly rising appearance, and the water will consequently shoot clear of the stack; but if the shears are used incorrectly, and the eave appears sloping downwards, water will find its way into the stack.

Labour and Expense.

Working single-handed, a man should complete five "squares" in a day of ten to ten and a half hours, though the work may be done much more rapidly. A "square"

represents a hundred square feet. The usual cost of thatching a square amounts to 11*d*. or 1*s*., while for straw ricks the amount may not be more than 8*d*. or 9*d*. Hazel rods may be purchased for 2*s*. 6*d*. to 5*s*. per 100 according to locality, with 25 rods in a bundle, and two bundles will generally be found sufficient to complete the thatching of ten "squares."

Thatching of Dwelling-Houses, &c.

A thatched roof has a picturesque appearance, which is by many preferred to the grey slate or red tiles which top the modern country cottage, while this method of making roofs watertight is adopted to a considerable extent in the case of such erections as summer houses, pavilions, and arbours. Different methods of thatching are practised in different districts, but the following may be taken as suitable for general purposes.

Preparation of Straw.—Straw is the most usual medium for thatching houses, and it is employed in one of two ways—firstly, by laying a covering of fibrous turf over the roof and pushing the straw through the turves; or, secondly, by sewing the straw directly to the roof.

The material must in all cases be prepared beforehand, this work affording a very suitable occupation to be carried on under cover during wet weather. The straw is simply drawn from the heap in the manner described above, the only exception being that more care is exercised to exclude all short ends or pieces of straw, so that, when properly prepared, it will be perfectly straight.

Making the Staples.—The yealm of straw is then gathered in the hands and a small quantity is pulled out at one end, turned down, and wound round the top of the yealm, forming what is known as a "staple." The projection thus formed at the head of the staple prevents it from being withdrawn once it has been inserted in the turves. When prepared in this manner, the staples are bound together a dozen at a time and stored in a dry place until required for use.

Preparation of Roof for Thatch (First Method).—The joists are fixed on to the roof in the usual manner, wooden runners being nailed on at about six inches apart; these runners are about three inches broad. The turves are placed upon the roof, working from the bottom and proceeding in an upward direction as with the slates. When cutting the turves, a curved cutting-iron must be used, so as to obtain turves thick in the centre but gradually tapering off towards the sides. Thus, when laid on the roof, the overlapping edges will make the turf covering level, and the roof will be of one thickness throughout.

Laying the Staples.—A thatching iron now becomes necessary. This implement is slightly forked at the apex in order to catch the twisted head of the staple of straw. In this manner the latter is pushed through the turf, and is prevented from coming out again by the "head" of wound straw. The work of laying the staples must be commenced at the eaves, and should proceed upwards until the ridge is reached; at this point a layer of turves is placed over the straw in order to form a "bolster" or well-defined ridge, and the thatching is then complete.

Preparing the Roof for Thatching (Second Method).—When preparing the roof for the second method of thatching, namely, sewing the straw directly to the roof, the joists are laid, the wooden runners nailed on, and the straw prepared in the same way. The straw is then sewn directly to the wooden runners, commencing at the bottom and working upwards to the ridge. Sewing twine is used for this purpose, and the work will be found quite a simple operation after a little practice has been obtained. In order to finish off the ridge, turves may here again be requisitioned as in the former method, or, as an alternative, two pieces of wood may be utilised. In the latter case, the boards should be cut to the same length as the roof and fixed so as to overlap the thatch for some distance on each side. This method of thatching is perhaps most extensively practised, as it is often impossible to obtain good, firm, fibrous turf.

Thatching with Heather, Reeds and Broom.—In certain districts heather is used extensively in the thatching of dwelling-houses, and particularly rustic summer houses, and similar buildings. This material is, of course, not always procurable in abundant quantities, but in the north and central counties of Scotland it forms the staple medium for thatching purposes. When carefully cut, heather will require but little preparation beyond straightening out. The roof is prepared as in the case of straw thatching (second method), and the heather sewn fairly tightly and closely together. This makes an excellent and very durable roof. Reeds, where they are procurable, are also a most valuable material for thatching purposes. They are used in a similar manner to straw, being either sewn direct to the roof or inserted through turves. Broom is used extensively in other districts in a similar manner to heather.

Cost of Thatching.—The cost of labour for thatching dwelling-houses, &c., generally amounts to 4*s.* 6*d.* per "square," or hundred square feet, while reeds cost as much as 5*s.* per square. On the roof of a dwelling-house, ten bundles, or 5 cwt., of straw will be required to each square of thatch, and one hundred of these bundles will cost approximately 105*s.* When thatching is carried out in a

thoroughly expert and experienced manner, the roof should remain quite watertight for about thirty years if composed of the finest quality wheat straw, or for forty years if reeds be employed. If, however, the work be done in an indifferent manner, it may not last for more than ten years.

Whitehall Place, London, S,W.,
June, 1910.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place. London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 237.

BOARD OF AGRICULTURE AND FISHERIES.

Redwater in Cattle (Bovine piroplasmosis).

Definition.

Redwater is a popular name applied to a disease of cattle due to the entrance into the blood of a very small (protozoal) parasite known as piroplasma. If not identical with the disease described in America as Texas Fever, which is prevalent in many parts of the world outside Texas, the form of the disease met with in England belongs to the same class, that is to say, it is due to the invasion of the red blood cells by piroplasms.

The Parasite.

In 1888, Smith and Kilbourne, working in America, showed that Texas Fever was due to small parasites (*haematozoa*) which invaded the red cells of the blood. These parasites, which are of microscopical size, assume various forms in preparations made from the blood, but they are chiefly either pear-shaped or round, and very frequently the pear-shaped forms occur as twins. This has led to the parasite being named *Piroplasma bigeminum*. In the twin forms found in the Texas disease the pear-shaped parasites are usually joined at their pointed extremity, and the more bulbous parts lie close together or may even touch each other. In 1901 the late Professor Nocard observed similar parasites in the blood of Irish cattle suffering from redwater, and since that date several veterinary surgeons have made similar observations in Great Britain and Ireland. As the result of experimental observations made at the Veterinary Laboratory of the Board of Agriculture and Fisheries, by McFadyean and Stockman, and published in 1908, it was shown that the disease known in Great Britain as redwater certainly belongs to the same class of disease as Texas Fever, that is to say, it is a piroplasmosis. On continuing the study of this disease in Great Britain the same observers have found that redwater in British cattle is caused by two species of piroplasms which are clearly distinguishable from each other. One form appears to be identical with the parasite described by Smith and Kilbourne and which is known as *P. bigeminum*, while the other, which is also bigeminate but very much smaller, has been named *P. divergens*, because the bulbous portions of the double parasites are very widely separated from each other. Numerous observations

in connection with the pathology, method of infection and spread of the British disease, were also made at the Board's Laboratory and supplemented by other observations made in the field. These observations, which will be referred to more particularly in another part of the leaflet, have shown that while an attack of the one form of the disease protects against a second attack of the same form, it does not protect against the other form. They have also shown, however, that the chief characteristics of the disease are not altered by the fact that two different species of piroplasms are concerned in its causation.

Method of Infection, and Spread.

In 1893, Smith and Kilbourne demonstrated experimentally that the blood of animals affected with Texas Fever, or of those which had recovered from the disease, was infective when injected into other animals which had not previously suffered from Texas Fever. In order to understand properly the method of infection and spread under natural conditions it is important to note that the blood of recovered animals may be infective when inoculated into others, and that experimental observation has proved beyond doubt that the blood of such an animal may retain its infective property for a very long time,—it may be for months and even years. Observations made at the Board's veterinary laboratory in relation to the blood of animals suffering or recovered from British redwater have shown that such blood is infective to others by inoculation, but it would appear that the blood of recovered animals does not retain its virulence for so long a period as in the case of Texas Fever and African redwater, although it may be virulent for several months after the animal has recovered.

Although piroplasmosis is caused by an infecting parasite it is well known that sick and healthy animals may freely mix together in a stable without the latter becoming infected. In fact, one may say that it is impossible to infect healthy animals by allowing them to mix in a stable with others suffering from the disease. Nevertheless, it would be wrong to say that the sick or recovered animals are unconnected with the spread of redwater. The explanation of this apparent paradox is that under natural conditions an intermediate carrier is necessary for the conveyance of the disease from one animal to another. Smith and Kilbourne showed that the carriers of infection from one animal to another were the progeny of female ticks* which had sucked the blood of animals suffering from the disease or recovered from it. Apparently the infection taken in by the

* The tick is not to be confused with the common sheep "ked," which is sometimes erroneously called the sheep tick, but which is really a louse and not a tick (*See* Leaflet No. 145).

mother-tick passes through the eggs to the larvæ, and many of the latter are capable of infecting new animals upon which they afterwards engorge themselves.

It is to be noted that the American tick which carries disease is what is called a "one-sucker," that is to say, when the female larvæ attach themselves to a bovine host they remain on the same animal until they are fully engorged and have paired with the males, after which they drop on to the pastures and lay eggs. It is clear, therefore, that were it not for the fact that the infection passes through the eggs of these ticks to the larvæ, this class of tick would be incapable of spreading disease, since it stays on the same host during the whole period of its development.

Arrangements were made to have collections of British ticks obtained from cattle and sheep sent to the Board's laboratory, and it was found that they belonged to two varieties—*Haemaphysalis punctata* and *Ixodes ricinus*.* These ticks are what may be termed "three-suckers," that is to say, they feed on three different hosts. The larvæ suck for a period on one host, after which they drop off and moult, becoming nymphæ. When the moult is complete the nymphæ go on to another host and again engorge, after which they drop off and moult into adults. The adults seek a third host upon which to suck. When the adult females are fully engorged and have paired (there is some reason to believe that pairing may also occur after the female has left the host) they drop off to lay eggs, which under favourable conditions hatch into larvæ.

There was therefore a possibility that the British ticks might be infective in three stages: (*a*) if an adult female sucked on an infected animal, assuming that the infection might pass through the eggs to the larvæ of the British tick, the larvæ might be capable of carrying infection to other animals; (*b*) larvæ might suck on an infected animal and as nymphæ (after moulting) convey the disease to the second host; (*c*) the nymphæ by sucking on an infected animal might (after moulting) convey the disease as adults to another animal.

It is of importance, however, to explain that the infected ticks do not simply convey the disease mechanically, that is to say, the bite of the infecting tick is not comparable to the inoculation of infective blood taken directly from a sick animal. What happens is that the parasite undergoes a cycle of development inside the body of the tick and it is conceivable, of course, that all stages of the British tick may not be suitable to the development of the parasite. From the observations made with British ticks at the laboratory, where *Haemaphysalis punctata* was reared in considerable numbers,

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* *See* Leaflet No. 145.

it would appear that this is probably the case. Individuals of this species in different stages of development were made to suck on the ears of animals which had been infected with British redwater; the engorged forms were caught in cloth ear-caps, and after they had moulted they were placed on fresh susceptible animals. Experiments with larvæ hatched from infected mothers failed to convey the disease. Those conducted with nymphæ which as larvæ had sucked on infected animals also failed. It was found, however, that adults which had sucked on infected animals as nymphæ could convey British redwater to susceptible animals. The number of experiments performed would hardly justify the conclusion that the adult which has infected itself as a nymph is the only stage of the tick which can convey the disease, but it is probable that it is the stage which most frequently conveys it, and certainly the observations put it beyond all doubt that British redwater is tick-borne.

The above experiments were made mainly with *Haemaphysalis punctata*, but field observations show that *Ixodes ricinus* is of equal if not more importance in the spread of the disease. After what has been said about the infective condition of the blood of sick and recovered animals it will be apparent that these animals act as cisterns, as it were, for the prolonged up-keep in their blood or organs of the parasites causing the disease, and that ticks on pastures may become infective and carry the disease to other bovines after sucking on infected individuals.

Seasonal appearance of the disease.

The various stages of the British ticks usually remain on the bovine hosts for a period of about five days, with the exception of the adult females, which suck for a much longer time—about ten days.

The time occupied in hatching or moulting varies very much according to the weather. Hatching and moulting seldom take less than three weeks, but may take much longer, even months. March to June and October to November are the two periods of the year in which the adult forms (which are apparently the most dangerous) are most prevalent in the field. It is at these times of the year that redwater is most frequently met with. Outside these periods, however, odd cases of the disease occur, the reason being that although the periods mentioned are those at which the dangerous stages of the tick are most prevalent, they do not all accomplish the moult at the same time; some are earlier and some are later. The period of time which elapses between infection being received from the tick and the appearance of definite symptoms is about ten days, but it may be slightly longer. It should be understood, however, that

the ticks of themselves are harmless, and that they only become capable of spreading redwater after they have sucked on an animal suffering or recovered from the disease.

Symptoms.

The disease obtained its name, redwater, because it was believed that the affected animals always passed red urine. The parasite causes a breaking up of the red blood cells, the colouring matter of which is set free. This coloured material is excreted in the urine, giving it a colour varying from dark red to that of black coffee. A clinical study of the disease in the laboratory, however, shows that the parasites may not destroy a sufficient number of red cells to cause the appearance of red urine. In fact, it would appear probable that red urine is not passed by the majority of infected animals, and on this account the disease is frequently passed over. The other symptoms are high temperature, 105° to 107° F.; loss of appetite; severe constipation, and in some cases diarrhœa. It should be noted, however, that the recovered animal may suffer from a relapse, since the infective agent may remain in the body for a considerable time after apparent recovery, and it does not always follow because an animal has clinical symptoms of redwater outside the usual periods of prevalence that it was infected by ticks a short time before the typical symptoms appeared.

Treatment.

The death-rate from redwater in this country is not high but the disease may cause the animals to fall off very much in condition, and in milch cows it causes a great diminution of the milk yield. Patients require very careful treatment by the veterinary surgeon, who should be called in immediately symptoms are noticed, as the disease is amenable to careful treatment.

Prevention.—One of three methods may be adopted for preventing losses from redwater: (1) preventive inoculation; (2) eradication of the ticks from the pastures; and (3) purification of the ticks without destroying them. There are many farms upon which ticks are found although redwater does not exist. In stocking such farms with cattle one should be careful not to make use of animals from redwater districts as they often carry the infection in their blood and might easily enough infect the clean ticks.

(1) *Preventive Inoculation.*—If non-infected and susceptible animals be inoculated with a proper dose of the blood of an animal a month or more recovered from redwater they, as a general rule, develop a more or less mild attack of

redwater from which they almost always recover. After recovery they present a considerable degree of resistance to future attacks. The inoculation if resorted to, however, should be performed on animals when under cover. The temperature should be taken daily, and on the first appearance of fever the veterinary surgeon will be in a position at the very commencement of the disease to give the animals any medical attention which they may require. For the purpose of reducing losses, inoculation could be usefully performed on susceptible animals before putting them on to what are known to be infected pastures. The great objection to the inoculation method is that the inoculated animals when they go to the pastures are capable of further infecting the ticks. There are certain pastures, however, the nature of which makes it impossible to eradicate or purify the ticks, and under these circumstances one may be forced to fall back on preventive inoculation.

(2) *Eradication of the Ticks.*—If the pastures be heavily infested with ticks, a rather rare contingency in this country, one may attempt to reduce their numbers by dipping the animals while the ticks are attached to them. For this purpose it is well to put a large number of sheep (which have been shown not to be susceptible to redwater) on the pastures as "tick collectors," the sheep being subsequently dipped to kill the ticks.* The best times for dipping to destroy ticks are those mentioned above under the section dealing with the seasonal appearance of the disease. At these periods the adult forms, that is to say, those which when fully engorged will drop off and lay eggs for the continuation of the species, are most in evidence. Moreover, the adult forms remain on the animal for a longer period than the others, namely, 10 days, so that a better opportunity is afforded of getting a large number on the animals at one time. It must be noted that dipping an ox which has already got infected ticks upon it will not necessarily prevent it becoming infected. The object of dipping is to get rid of the ticks from the pasture. There are various objections to the dipping method. Close observation shows that none of the dipping materials commonly used have a particularly destructive effect on ticks, nor can they be relied upon to keep ticks off the animal for any considerable time. It may indeed be pointed out that dips for the destruction of ticks have acquired a reputation in excess of their value, owing to the fact that in order to complete their development the British ticks naturally drop off their host in a few days, and the dip often, though wrongly, gets the credit of having killed them and made them let go their hold.

* *See* Leaflet No. 145 (*Sheep Dipping*).

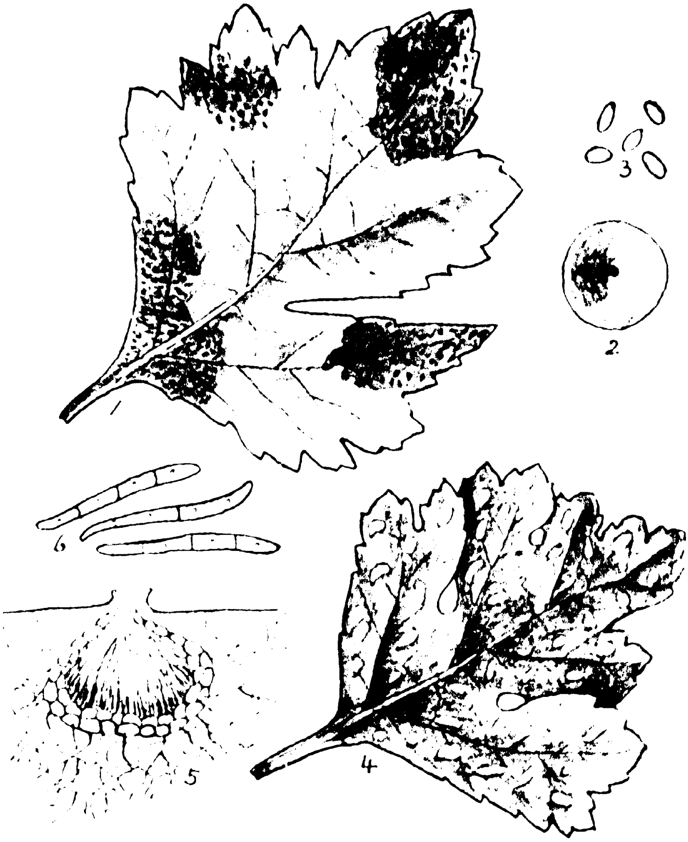
Purification of the Ticks.—Without destroying the ticks one may get rid of the infected ones from the pastures by keeping cattle off for a time, and this method is the one which promises most finality. The period, however, is a long one, as the various stages of the tick are capable of prolonged existence in the event of no host being available. Probably cattle would have to be kept off the pastures for about 14 months to ensure purification. The cleansing of the ticks may be hastened, however, by heavily stocking the pastures with sheep. The latter animals are not susceptible to redwater, and the ticks by sucking on them get rid of their virus without doing the sheep any harm. If it be not possible to utilize the infected pastures for sheep alone, the number of cases of redwater can be greatly reduced by running sheep on the pastures in conjunction with cattle. Many of the infected ticks will then go on the sheep and in this way be diverted from their bovine hosts. The Board have reason to believe, from actual observations made at their instigation, that the pasturing of sheep with cattle on infected fields gives good results.

Whitehall Place, London, S.W.,
May, 1910.
Revised, August, 1914.

Leaflet No. 238.

BOARD OF AGRICULTURE AND FISHERIES.

Leaf Diseases of Celery.



1.—*Phyllosticta apii* on celery leaf. Nat. size. 2 and 3. Perithecium and spores of *P. apii*. Highly magnified. 4.—*Septoria petroselini* on celery leaf. Nat. size. 5.—Section of perithecium of *S. petroselini*, embedded in a leaf. Highly magnified. 6.—Spores of *S. petroselini*. Highly magnified.

"Celery leaf-spot" caused by *Phyllosticta apii*, Halsted, was first observed in the United States in 1891, and since that date it has repeatedly proved to be a destructive parasite

on celery. The foliage is the part attacked, and the disease is readily distinguished among the several leaf parasites of celery by the presence of one or more large blotches on a leaf. These blotches are at first dull brown, afterwards paler, dry, and studded with numerous black points or perithecia, each containing numerous very minute spores. When the spores are ripe the dead portion of leaf on which they are produced crumbles and falls to the ground, carrying along with it the spores of the fungus, which infect the soil and prove a menace to following crops. Numerous spores are also liberated at the moment of maturity, and are conveyed by various agents to adjoining leaves, by which means the disease spreads with great rapidity during damp, dull weather. During 1909 this fungus appeared in Sussex in the form of an epidemic in a field of celery, and much injury was experienced.

A second celery leaf disease caused by a parasitic fungus called *Septoria petroselini*, Desm., has been long known in this country and on the Continent. In this instance the leaf becomes studded with numerous small, irregularly angular, brown spots, each bearing a few very minute black points or perithecia, containing myriads of very slender needle-shaped spores. When this fungus attacks celery an epidemic usually results, owing to the rapid production and dispersal of spores.

Preventive Measures.

The two diseases indicated are practically indistinguishable to the naked eye and both yield to the same method of treatment, provided that preventive measures are commenced at a sufficiently early stage. On the first appearance of the disease the plants should be sprayed with Bordeaux mixture* made of 12 lb. sulphate of copper and 8 lb. of freshly burnt quicklime to 75 to 100 gallons of water. Three applications at intervals of a week usually prove sufficient to check the progress of the parasite. The injury caused is most serious when the foliage is attacked during an early stage of growth, and careful watch should be kept on the crop, more especially in districts where the disease is prevalent.

* Exact instructions for making Bordeaux mixture are detailed in Leaflet No. 23 (*Potato Disease*).

Whitehall Place, London, S.W.,
May, 1910.

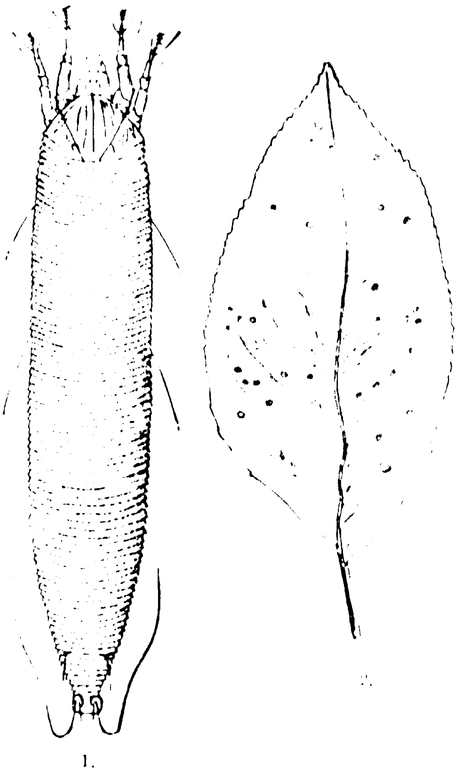
Revised, April, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 239.

BOARD OF AGRICULTURE AND FISHERIES.

The Pear Leaf Blister Mite (*Eriophyes pyri*, Nalepa).



1.

PEAR LEAF BLISTER MITE (*Eriophyes pyri*, Nalepa).

1.—The Mite (greatly magnified).
2.—An infested pear leaf, showing blisters caused by the Mites.

The Pear Leaf Blister Mite (*Eriophyes pyri*, Nalepa) is a troublesome enemy of the pear tree and seems to be on the increase. Specimens of the galled leaves have been sent to the Board from Norfolk, Sussex, Wilts, Dorset, Devon, Somerset, Hertfordshire, Shropshire, Cheshire, Lancashire and Yorkshire. Theobald and Collinge record cases in

Bedford, Cambridge, Cheshire, Cornwall, Lincoln, Northampton, Surrey, Warwick, Worcester, and also from Wales. The mite is probably distributed over the whole of England, but it does not appear as an epidemic. Trees often remain unattacked in a garden, though in close proximity to badly infested trees.

Trees Attacked.

The Pear Leaf Blister Mite is an example of a species of *Eriophyes* which feeds on plants of different genera of the same Natural Order. According to Nalepa's list it infests not only the Pear but also the following other British rosaceous plants:—Apple, White Beam Tree (*Pyrus Aria*), Wild Service Tree (*Pyrus torminalis*), Rowan or Mountain Ash (*Pyrus Aucuparia*), and the rare *Cotoneaster vulgaris*. The Board's records, however, refer to pear trees only.

The apple is very commonly attacked in America, as well as the pear. In Britain complaints relate chiefly to the destruction of the foliage of the pear, with the consequent effect on the fruit. Mite-infested pear leaves show characteristic raised patches or blisters (Fig. 2) with a minute opening on the under side. The raised patches or blisters are red, or green-red, or green, and later brown or brown-black.

In his Report for 1896, Theobald recorded direct damage by this mite to the young developing pear fruits, blisters or galls in which the mites were present showing on the outside of the attacked fruitlets; these fruits were quite destroyed or remained stunted.

The Board have a similar record of such attack on pear fruits. In this case the plant trained on a wooden paling about eight feet high had done well for some years previous to 1907. In 1907 this plant produced abundant bloom, but "when the pears were of the size of small peas both leaves and pears showed attack and all the pears but one dropped off. In 1908 the same thing again occurred, all the young pears dropping off."

Description of the Mite.

The Mite is minute. Nalepa's measurement is from $\frac{1}{147}$ to $\frac{1}{125}$ of an inch long. The magnified figure (Fig. 1) indicates the mite with its rounded body and elongated form. The anterior end of the body (cephalo-thorax) has a semicircular shield on its upper surface. In front is the rostrum with its piercing and sucking mouth parts. There are two pairs of 5-jointed legs; each leg ends in a claw with a 4-plumed bristle. The abdomen is transversely ringed. On the upper surface of the mite and springing from the hind edge of the shield are two bristles. The abdomen bears

two bristles towards its front end; about the middle are two moderately long bristles; near the hind end are two very short bristles; while there are two long bristles at the tail.

In the larval state the mite resembles the adult in external appearance except for the smaller size, a weaker bristling, and the absence of external sexual apparatus. In colour the mite is whitish.

Life History.

The winter is passed under cover of the outer bud-scales of the buds on the shoots of the year. In this position the mites shelter in numbers. In spring the mites proceed to gall the young leaves (Fig. 2). The adult female lays her eggs in the gall. New broods of mites spread from the galls, forming fresh blisters on the same and other leaves. Before leaf-fall the mites pass to their winter quarters in the buds.

Treatment.

A winter wash either of lime-sulphur or paraffin emulsion is usually recommended for blister mite, both in this country and in America. In adopting any of the following suggestions the grower must take into account local conditions and the intensity of the attack. In mild cases a single application of a winter wash may be sufficient, but where the attack has become serious it is wiser to make two applications as suggested below.

(1) *Lime-Sulphur Washes.*—A lime-sulphur wash at winter strength may be applied after the leaves have fallen in the Autumn (November approximately) and again when the buds begin to swell in Spring (February approximately). Owing to the variations in strength found in most home-made lime-sulphur washes it is generally better to buy the concentrated wash from a reliable manufacturer who will provide the necessary instructions as to dilution.

In experiments at Wye, Theobald found that a lime-sulphur-caustic-soda wash applied in November and February was more effective than either lime-sulphur alone or paraffin emulsion. His formula for such a wash, in addition to lime-sulphur, contains 1 lb. of caustic soda and 1 lb. of soft soap to each 10 gallons.

(2) *Paraffin Emulsions.*—Paraffin emulsion may also be used at the periods recommended in the case of lime-sulphur. In Bulletin 283 of the New York Experiment Station one part of standard paraffin emulsion in six parts of water is suggested. In this country one part of standard emulsion in 10 parts of water is the strength usually recom-

mended for a winter wash. The standard emulsion referred to in Bulletin 283 appears to be composed as follows:—

Paraffin	... ...	2 gallons.
Water	... ...	1 gallon.
Soft soap	... ...	½ lb.

The soap should be dissolved in boiling water and while still hot the paraffin should be added, the whole being thoroughly churned.

A dilute emulsion is stated to be of service when applied to the foliage in early summer. Such a wash might be obtained by diluting one part of the standard emulsion described above with 25–30 parts of water.

(3) Where an attack is noticed before the mites have spread, or where only a few small trees are affected, the blistered leaves may be collected and burnt.

Whitehall Place, London, S W.,
July, 1910.

Revised, August, 1911.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Farm Book-keeping.

No set of books or system of book-keeping can be recommended as the best for farmers under all circumstances. Much depends upon the size of the holding, the class of business carried on, whether there is any retail trade in such things as milk or other dairy produce, or poultry, and, lastly, upon the capabilities of the farmer himself and the amount of time and labour he is willing to devote to accounts.

I.—A Simple System.

One of the principal points which has retarded the general adoption of book-keeping on small farms is the amount of clerical work involved. For such holdings, where the farmer usually works with his men, it is best to use a very simple system requiring few books or different places of entry. Methods similar to that recommended by the judges of the Royal Agricultural Society's Farm Book-keeping Competition in 1883 are well adapted for such cases. A short description of the books to be kept is given below.

(1) *Diary.*—A diary is intended to contain daily notes of cultivations, manures applied, crops sown or harvested, quantities threshed, foods consumed, and any observation the farmer may think worthy of being recorded. Columns should be provided for daily receipts and payments, and also a form for labour account. The whole of the entries for the day, however varied in character they may be, are made in this book. The following is an example of the form, but the space allotted to each day's entries would, of course be much greater :—

Diary.

Date.			Received	Paid.
	Brought forward			
	Saturday	[In this space, a record should be made of all farm work, purchases, sales, orders, &c.]		
	Sunday			
	Monday			
	Tuesday			
	Carried forward			

Weekly Labour Account.

Name of Labourer.	S.	M.	T.	W.	Th.	F.	Total.	Rate of Wages.		
					Carried forward ...					

(2) *Cash Analysis Book.*—This is a book to which receipts and payments are transferred from the diary and entered in columns to their proper accounts. Any number of columns may be provided; one should be allowed to each class of stock, produce or other items of which it is desired to keep a separate record, as in the example below. At the end of the year the totals of these columns will show the total receipts or payments made during the year in respect of each of these items, *i.e.*, the receipts for cattle, sheep, corn crops, &c., and the payments for food, rent, manure, labour, &c. Money due but not received for goods sold during the year should be added to the receipts table, and payments due but not paid should be added to the payments table, because they belong to the current year's account and influence the profit and loss. Sums received and paid during the year, but belonging to the previous year's account should be deducted from the receipts and payments tables respectively. This is shown in the following specimen pages. For convenience the totals should be made up monthly and transferred to a summary page.

CASH ANALYSIS BOOK.—RECEIPTS PAGE.

Date.	From whom received and particulars.	Cattle.	Sheep.	Pigs.	Dairy.	Poultry.	Corn Crops.	Hay.	Sundries.	Value of produce used by household.
	Total at end of year.									
	Add money owing but not received.									
	Deduct money received but owing from previous year									
	Total sales for the year.									

CASH ANALYSIS BOOK.—PAYMENTS PAGE.

Date	To whom paid and particulars.	Cattle	Sheep	Horses	Pigs	Seeds	Foods	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Total at end of year...											
	Add money owing but not paid.											
	Deduct money paid but owing from previous year.											
	Total payments and expenses for year.											

Profit and Loss Account. The Profit and Loss Account is prepared at the end of the year, after a valuation of stock, as follows:—

PROFIT AND LOSS ACCOUNT

To Valuation of live and dead stock, tillages and unexhausted improvements at beginning of year ...		By Sales and receipts from Analysis Book, viz.	
To Payments and Expenses from Analysis Book, viz.		Cattle	
Cattle		Sheep (including Wool)	
Sheep		Pigs	
Horses		Dairy	
Pigs		Poultry	
Seeds		Corn crops ...	
Foods		Hay	
Manures ...		Other produce ...	
Rent		Sundries ...	
Rates, taxes, &c.		By Valuation of live and dead stock, tillages and unexhausted improvements at end of year	
Labour		Farm produce used by household ...	
Sundries ...			
To Balance—profit for the year ...			

Household expenses are not entered in the Profit and Loss Account, since they have no bearing on the profitableness of the business. The value of farm produce consumed on the holding should be entered in the Receipts book in the same way as if it were actually sold.

The foregoing system of accounts has the advantage of being easily understood and little liable to errors. It does

not show even the approximate profit or loss on the different branches of the business, but it presents in a concise form the materials from which, with a little study and trouble, a very close estimate of these may be made. It may be recommended to those farmers who have not previously kept accounts, or who have a disinclination for books.*

II.—A Fuller Method.

A complete and much more exhaustive set of accounts may be kept by means of a cash book, a ledger, and a labour book. The cash book serves for the record of receipts and payments. Accounts are opened in the ledger for the various crops, kinds of stock, and classes of expenses of which it is desired to keep separate account, in order that the approximate profit or loss resulting from each may be known.†

The number and character of these accounts will vary according to the class of farming carried on, and each farmer must decide for himself what accounts to open. Each account is debited with the value of that particular class of stock in hand, or, in the case of crops, with the cost of cultivations, seeds sown, &c. The cost of labour must be divided up amongst the various items. All receipts appearing in the cash book are carried to the credit of their proper ledger accounts and the payments to their debit. At the end of the year a valuation must be made, and the value of stock in hand, or sold but payment not yet received, and of cultivations, is placed to the credit of the accounts, and that of purchases not yet paid for to their debit. The balance, gross profit, or loss, is transferred to Profit and Loss Account.

Except on farms where there are numerous credit sales, it is unnecessary to open accounts in the ledger for each person or firm with whom business is done. The large number of personal accounts which appear in many published examples of farm book-keeping form one of the main causes of the apparent complication of the systems advocated. Where the credit dealings are few, the records in diary or notebook are sufficient for them. When the credit dealings are numerous it is necessary to enter them in a day book and to transfer them to personal accounts in the ledger, preferably a ledger kept specially for them.

Profit or Loss on Various Departments.

Accounts kept on the system above described will enable a farmer to ascertain with at any rate approximate accuracy

* The Royal Agricultural Society publishes ruled account books for a similar system. These are obtainable from Messrs. Forster, Groom and Co., 15, Charing Cross, London, S.W., price 9*s.* 6*d.*

† The Institute of Research in Agricultural Economics, University of Oxford, is prepared to co-operate with farmers in keeping their accounts on these lines. No charge is made and the accounts are treated as strictly confidential. Farmers wishing to obtain further particulars should communicate with the Director of the Institute.

the profitableness or otherwise of the various departments of his business. Manufacturers who produce a variety of wares keep cost books, in which each class of stock produced is debited with—

(1) Cost of all materials used; (2) Wages paid to workmen; (3) A proper proportion for rent, supervision, interest on capital and profit.

By this means the manufacturer learns the exact cost of his wares, a knowledge which is essential to him if he is to conduct his business successfully. Knowledge of the exact cost of producing the things he sells is just as useful and necessary to a farmer, and can be obtained by him in a similar manner, though it is difficult to secure absolute accuracy because of the influence which the various items have upon each other. For example, the action of some purchased manures, as well as of dung, extends over several years, and benefits many crops, and it is difficult to fix the amount which should be charged to the crops of a particular year; while in the case of foods the total cost cannot be charged to the stock which consume them, for crops benefit from their manurial residues.

In order to ascertain as nearly as possible the return from each of the separate branches of farming, *e.g.*, from fat stock, dairy cattle, arable land, &c., it is necessary to keep records showing:—

1. Distribution of feeding-stuffs, whether concentrated or bulky, purchased, or home-grown, so as to know the amounts consumed by the different classes of stock and thus be able to charge the cost against the proper ledger account.
2. Stocking of pastures and use of grass keep.
3. Distribution of seeds and manures.
4. Employment of labour, both horse and manual, and the wages paid in such a form that the expenditure on behalf of the various accounts is shown. This daily record must state the employment of each labourer, or the account on behalf of which he has been engaged.

The following is a form which has been found effective for this purpose. It is based on one recommended many years ago in Morton's Cyclopedia of Agriculture.

	Nature of Employment.							Amount of Wages chargeable to					
Wages.	Name of Labourer.	S.	M.	T.	W.	Th.	F.	Corn Crops (1.)	Roots (2.)	Clover (3.)	[illegible] (4.)	Cattle (5.)	Sheep (6.)
								s. d.	s. d.	s. d.	s. d.	s. d.	s. d
18	Jones ...	5	1	2	1	2	2	6 0	3 0	—	—	3 0	—
18	Smith ...	6	5	3	1	3	1	9 0	—	3 0	—	3 0	3 0
18/	Brown ...	5	4	3	5	2	6	—	3 0	3 6	3 0	6 0	3 0

The figure in the "nature of employment" columns refers to the item in the next series of columns, and shows the account to which the man's wages are chargeable. These latter columns will be identical with those for which it has been decided to open ledger accounts, and the total amount of each wages column in this labour book should be added up monthly and transferred to the ledger, which will then show the sum expended in wages in respect of each account.

The same book may be used to record the number of horses employed in respect of the various accounts, but no charge should be made for them until the end of the year. The net cost of maintaining the horses should then be ascertained and this sum divided among the accounts in proportion to the work done for each.

With the exception of the labour book, these records do not necessitate frequent entries. The form in which they are kept will depend upon the division of the accounts. For example, if the live-stock accounts comprise only one for cattle, one for sheep, and one for pigs, the record for feeding-stuffs and grazing will be fairly simple. If, however, each of these is divided, as is desirable, into breeding stock, store stock, and fattening stock, the record becomes more complicated and troublesome to keep. Similarly, with seeds and manures, if only one account is kept for arable land, the record is little trouble, but this is much increased if an account is opened for each kind of crop grown.

By means of these records the expenditure on feeding-stuffs can be distributed amongst the live-stock accounts; that on manures and seeds amongst the arable and the meadow-land accounts; wages and cost of horse labour amongst all the accounts on behalf of which work has been done; rent, rates, taxes, and insurance amongst both live-stock and crop accounts, and so on with the various expenses.

In the case of stock being transferred from one account to another—say, from store to breeding or fattening stock—an adjustment is made, the account from which they come being credited and the other debited. A similar adjustment is necessary for the manurial value of foods consumed, the crop account which benefits being debited and the live-stock account credited.

The extent to which such transfers and adjustments are made will depend on the character of the farm and the produce dealt in, but the principle is the same throughout, the object aimed at being to charge each separate branch of the business for which an account is kept with the whole of the direct and indirect expenses which it involves or from which it benefits, and to credit it with its due proportion of the receipts, in order to ascertain the real profit or loss on that particular branch.

When and How to Commence Farm Accounts.

The correct time for a farmer to commence his farm accounts is when he enters upon the business of farming. All is then straightforward as regards opening the books. He begins with a certain amount of cash, which he enters as a receipt in his cash book, and his payments for live and dead stock, cultivations, &c., are duly entered and posted to their proper ledger accounts as these are opened. For one already in business the best time to commence systematic book-keeping is the usual date at which farm tenancies commence in the district. In this case the first step is a valuation of everything connected with the business, and the entry of the values in their respective ledger accounts.

Valuation.

A valuation at the close of each year is essential if the accounts are to show the true financial position of the farmer, or the profit or loss on particular departments. It is of the utmost importance that as exact an estimate of the values as is possible be secured.

There is a difference of opinion, however, as to whether the ordinary live stock of the farm, such as horses, cows, and ewes, should be valued in accordance with the fluctuations of the market at the prices prevailing at the time, or whether they ought to be valued each year at the same price per head for stock of a similar class and age. The former method shows the value which would be realised if the stock were sold, but, even in a time of inflated prices, they cannot be disposed of, as they are required for carrying on the business. In such cases this method may show profits which are not actually secured, while in a period when low prices prevail it may indicate losses which are not really sustained. Valuation at a regular and medium price per head is on this account to be preferred. So long as the quality of the stock remains practically unchanged it gives more exactly the profit actually realised under the circumstances, while it has the advantage of being less troublesome. This does not, however, apply to "flying" stock, such as cattle and sheep brought in for fattening. These must be valued at market prices, otherwise no correct estimate of the profit from fattening stock can be obtained.

In the same way the whole of the machinery and implements need not be valued individually each year. If, say, from 10 to 15 per cent. of the value of these, according to whether there is little or much expensive machinery which decreases rapidly in value, is written off each year as depreciation, the result will in most cases not be far wrong. Care must be taken to add the cost of new implements purchased during the year. A valuation in detail may be

made after an interval of a few years, to check the correctness of the allowance. It is desirable, however, that the allowance should be ample rather than otherwise.

Statement required for Income Tax Appeal.

Farmers who wish to appeal with a view to the repayment of Income Tax are required to furnish a statement of payments and receipts in a form prescribed by the Commissioners of Inland Revenue. A specimen form of account of profit and loss, indicating the headings under which payments and receipts should be classified in order to supply the information required by the Commissioners, is given in a Memorandum on *Farmers and the Income Tax* issued by the Board. Copies of the Memorandum, which also describes generally the position of farmers in regard to payment of Income Tax, may be obtained free of charge and post free on application to the Board.

Whitehall Place, London, S.W.,
February, 1911.
Revised, November, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Construction of Cow-houses.

The first requirement in the production of milk for human consumption is cleanliness, and one of the most important factors in securing clean milk is a well constructed cowshed.

It is comparatively easy to provide new buildings which will meet all requirements, but it is more difficult to alter an existing building so that it can be made as suitable as a new one. This fact, however, should not deter owners and occupiers from making alterations on the lines suggested, as even the most unsatisfactory buildings can often be much improved without great expense.

In designing a cow-house, the principal details which should receive consideration are the following:—

Site, including aspect and arrangement with regard to other buildings;

General Construction of the Building, including the walls, roof, floor, drainage, and water supply;

Internal Design, including arrangement of stalls, stall divisions, feeding troughs, manure and urine channels, and passages;

Air Space and Floor Space;

Ventilation, including the various methods by which this is attained; and

Lighting.

The Site.

If possible, the site should be moderately high and dry ground. The building should be conveniently placed for the supply of fodder and roots and the preparation and storage of feeding stuffs. In order to facilitate the removal of the manure and urine, the site should, where practicable, be on ground with a gentle slope.

There should be easy and ample access to the nearest pasture without interference with other stock, and without affording the cattle an opportunity to stray. To ensure ample sunlight a south, south-east, or south-west aspect is desirable,

and, while it should be sheltered from strong winds as far as possible, no cow-house should have any buildings, such as hay or straw sheds, or buildings occupied by other kinds of stock, erected against the side walls. In designing new farm buildings these points can be taken into consideration, but when existing buildings are being altered, difficulties may occur. With care and skill, however, the average building of the present day may be considerably improved.

General Construction.

Walls.—The walls may be of any suitable material which is plentiful and cheap in the district, and with the necessary precautions good buildings may be erected of stone, brick, concrete, wood, or wood and iron. If of stone or brick, all the walls should be neatly pointed, and, where economic considerations permit, it adds to the cleanly appearance and sanitary efficiency of the building if the inside face of the walls is built with salt-glazed bricks or cement finished with a smooth surface to a height of not less than 5 ft. from the floor. Above that height the surface of the walls should be of such a nature that they can be easily cleaned and disinfected or lime-washed. If the building is of wood, or wood and iron, all uprights, sills, and outer boarding should be of timber which has been creosoted under pressure. The extra expense of creosoting will not be great, while the life of the building will be considerably increased. To obtain sufficient cubic air space within the building the height of the walls should not as a rule be less than 8 ft. 6 in. from the threshold to the top of wall-plate.

Roof.—In recent years many kinds of roofing materials have been placed upon the market, and used with varying success, but for efficiency and endurance there is nothing to surpass slates or tiles. The building should be open to the ridge. In constructing the roof timbers, where the span does not exceed 30 ft., there is no cheaper or stronger form of support than the king-post principal for double cow-houses. For narrow spans for single cow-houses there are several kinds of roof trusses of simple design which can be adopted.

Doors.—The doors for the entrance and exit of the cows should be not less than 4 ft. wide in the clear, and should be hung in halves. Simplicity of construction should be aimed at, and it will be found that plain, strong ledged and braced doors are the most satisfactory and durable. The sharp angles of all door frames should be rounded off; and, where doors are hung in brick-

work, round-nosed bricks should be used to lessen the risk of injuries to the cows.

Floor.—The first point which should be considered in connection with the floor is its level compared with the existing roadway, or completed surface round the building. In many cases, particularly on level land, or where there is difficulty in getting sufficient fall for the drains, the floors are laid at too low a level, with the result that the floor and stalls are often damp, and the roadway outside is covered with mud and slush. In not a few instances the roadway outside is difficult to improve, as it cannot be raised, owing to the risk of running the surface water into the building, instead of away from it. Such conditions should be guarded against by laying the floor at a comparatively high level. If also the site does not slope so as to provide the requisite fall for purposes of drainage, the floor should be raised sufficiently to secure this.

The main flooring materials should be either cement concrete, or blue bricks. Where clean sharp sand and gravel are available, good cement concrete, not less than 4 in. in thickness, properly laid and finished, is probably the best material for general purposes. The finishing coat should be laid on as soon as the foundation concrete is sufficiently hard for walking upon, and before it is dry. This finishing coat should consist of two parts of finely crushed granite, and one part of cement, and should be at least 1 in. in thickness. The surface should be grooved or slightly roughened to prevent the animals from slipping. Care must be taken that the ground is quite even throughout, well rammed, and uniformly firm before laying the concrete. Properly finished concrete is scarcely ever slippery if clean, but may be more or less so if dirty. It is as cheap as any other flooring material laid equally substantially, is less absorbent than most, and probably more durable than any other. Where blue bricks are used for the passages and stalls, the bottom of the manure channel might be formed in cement so that there are no junctions to hold urine; the uniform gradient necessary for this part is also more easily maintained with cement than with bricks.

Whether the floor is made of cement concrete, or blue bricks, it will be advantageous to use rammed clay or chalk rubble for a space of 3 feet from the manger, as this will enable the cows to kneel with greater comfort and will prevent enlarged knees.

Drainage.—There should be no covered drains inside the cow-house. The urine from the gutter should be carried off by means of a 6-in. glazed pipe, which should run through the wall and discharge 6 in. beyond over a trapped gully,

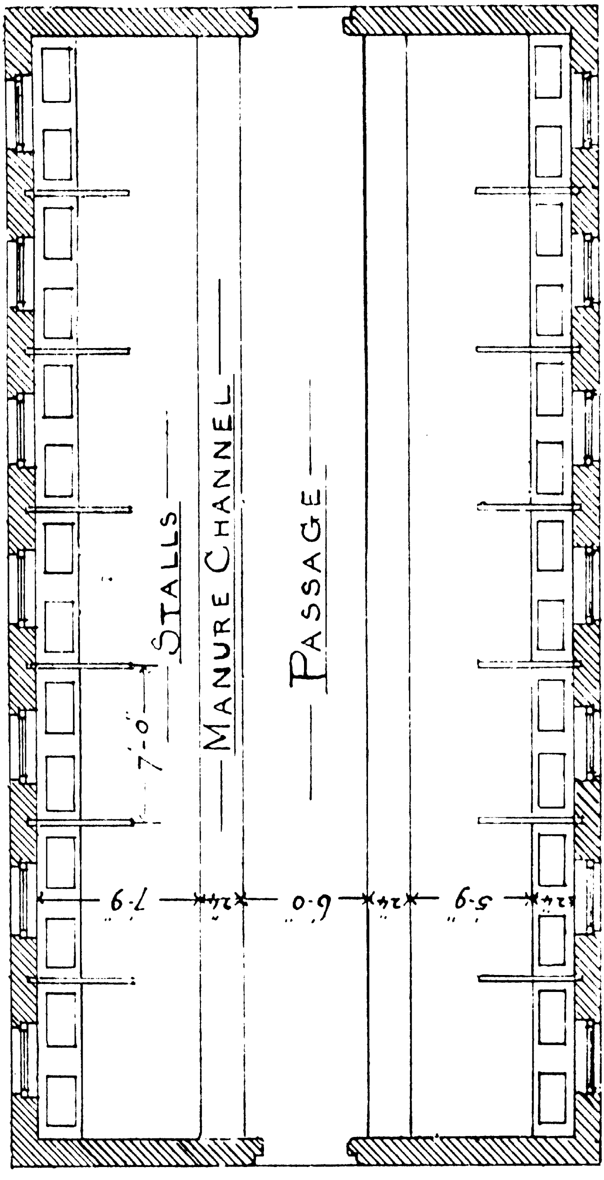


Fig. 1.—Ground Plan of Cow-house: Two Rows of Stalls, without Feeding Passage.

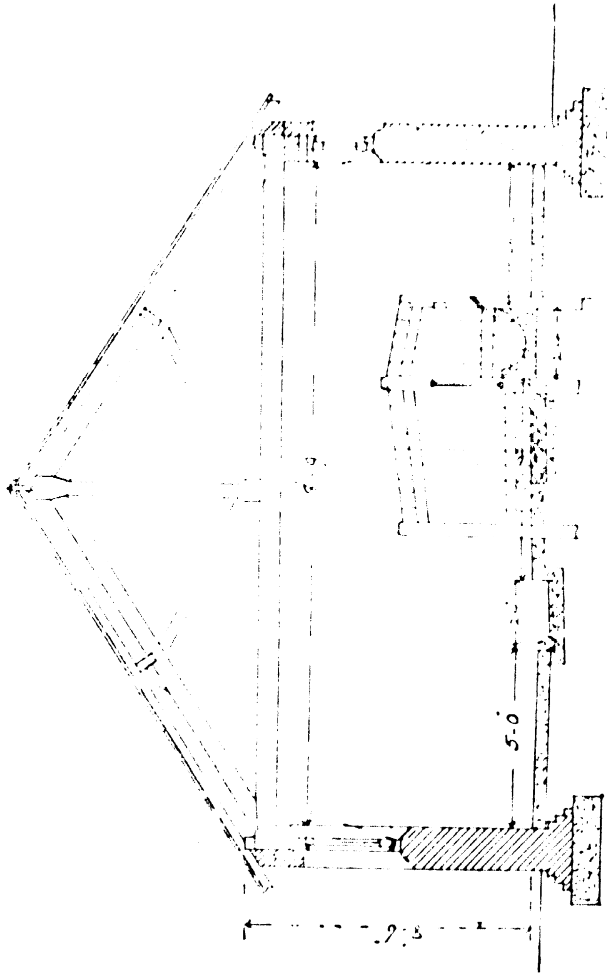


Fig. 2.—Cow-house with One Row of Stalls and Feeding Passage

or to the manure in the case of a covered yard; a grid should be fixed at the end of the discharge pipe to prevent solids entering the drains. The drains outside the cow-house should be as short as possible, and should have a good fall, otherwise they will be difficult to keep clear. Where the drain is of considerable length, or bends to any extent, inspection chambers with loose covers should be introduced.

A good plan is to have a watertight tank close to the dungstead into which all leakage from the latter should run, and into which the drain from the cow-house should discharge. A urine tank in such a position permits of the contents being distributed over the top of the manure heap, though it is best to apply it direct to the land, especially to meadows.* For raising the contents of the tank a chain or plunger pump should be fitted.

Water Supply.—The best water supply is that obtained from springs and streams, or other suitable sources of pure water at a higher level than the buildings, so that water can be brought to them by gravitation, which is the cheapest method. If such sources are not available, the rain-water should be collected in storage tanks fixed at a sufficient height to supply the cooling room and cow-house; alternatively, well-water may be pumped up into tanks.

It is desirable to arrange for an ample supply of water to the cow-house for watering the stock, for cleansing, and for a washing basin where the men can wash their hands before milking. Any tank for the storage of water used for the washing of the milkers' hands or the cows' teats should be properly covered and ventilated.

Internal Designs.

General Arrangement.—In many parts of the country the most common type of cow-house is that represented in Fig. 1, in which the cows are stalled with their heads facing one of the outside walls. In this type the one passage is used for conveying food to the cows, removing the manure, and taking away the milk. This arrangement is applicable to either single or double cow-houses.

The interior dimensions of this building (Fig. 1) give a total distance from side to side of 25 ft. 6 in., and its narrower span would enable a simpler roof truss to be used than the alternative plan shown in Fig. 3.

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* See Leaflet No. 93 (*Farmyard Manure*).

The method of stalling the animals shown in Fig. 2 is one of the most approved, particularly where existing farm buildings are being adapted; where, however, a new building is to be erected for a large number of cows, it will be more economical to adopt design No. 1. In Fig. 2 the same principle is followed as in Fig. 3, except that one row of cows is provided for instead of two.

Where there are less than 12 cows, and they are ranged in a single row, a feeding passage is not necessary. One is often provided because it is a convenient way of obtaining the prescribed amount of cubic space in the cow-house; but this end is often defeated in practice by the custom of using the feeding passage for the storage of fodder This is an objectionable system, and it would be far preferable to dispense with the feeding passage and store the fodder in a mixing house at one end of the cow-house; half the space in the mixing house could be included in reckoning the cubic space per cow, if it is only partially partitioned off from the cow-house.

The arrangement shown in Fig. 3 has a great deal to recommend it, and though the initial cost is fairly high, the advantages obtained may warrant the extra expense.

In one type of cow-house which is very common in many districts, and is frequently met with in most modern dairies in America and on the Continent, all the stock are fed from a central passage, while the manure and the milk are removed by the two passages at the side. In a building of this class the cows' heads are a long way from the fresh-air inlets, and the animals breathe into each others faces from opposite sides of the passage, so that exceptionally good ventilation is needed to maintain the general health of the cows. Moreover, such an arrangement is to be strongly deprecated as being likely to assist the spread of disease from animal to animal by inhalation.

Passages.—A feeding passage less than 3 ft. 6 ins. wide cannot be worked in with comfort, and a standard width of 4 ft. is preferable. The passage should have direct access to the mixing house or store.

Milking passages should be from 4 to 5 ft. wide for single cow-houses, and 5 ft. 6 in. to 6 ft. 6 in. for double ones. With a narrow passage there is always a risk of the cans and their contents being splashed and contaminated with urine or dung.

Stalls.—The floor of the stalls should be given a fall of about 2 in. from the trough to the manure channel; this will facilitate the drying of the floor after flushing with water.

In determining the length of the stalls regard should be had to the breed to be kept.

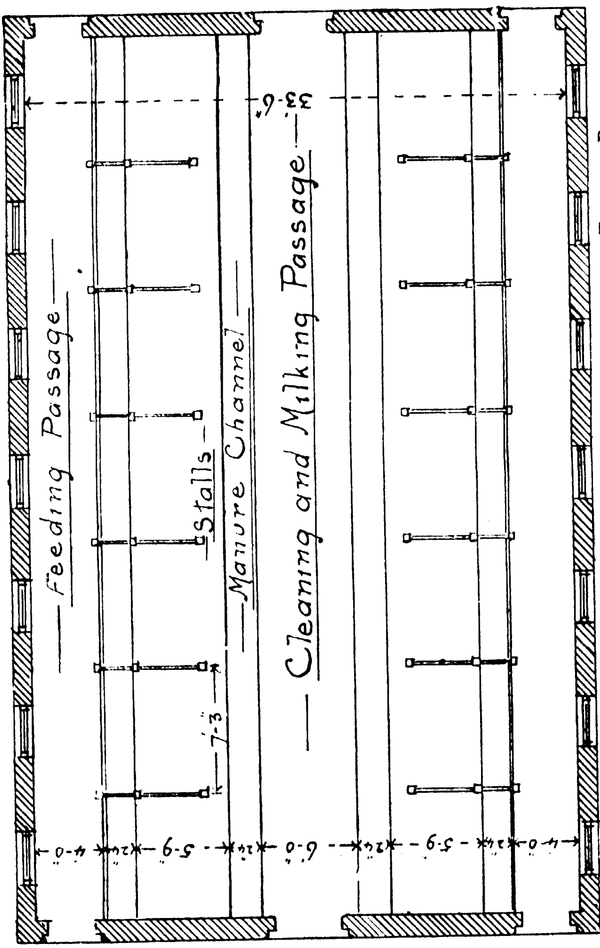

FIG. 3.—GROUND PLAN OF COW-HOUSE: TWO ROWS OF STALLS AND FEEDING PASSAGES.

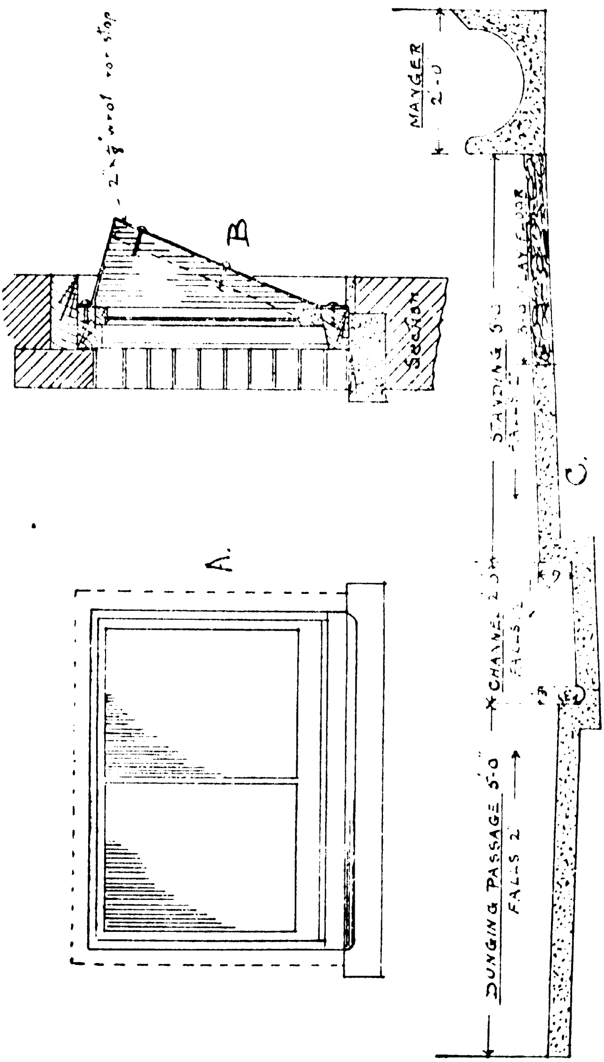

FIG. 4.—A. AND B. DETAILS OF HOPPER WINDOW. C. SECTION OF COW-HOUSE FLOOR: ONE ROW OF STALLS WITHOUT FEEDING PASSAGE.

For small cows, such as Jerseys, Kerrys, and young Ayrshires, the stall (measured from the manure channel to the wall or division between the cows and the passage) should be about 7 ft. long, inclusive of the breadth of the trough. For Ayrshires, a stall of 7 ft. 3 in. is quite sufficient, while Shorthorns require 7 ft. 6 in. to 8 ft.

If the stalls are too short, the cows will stand in the manure channel, and sooner or later their hind feet become soft and diseased. If the stalls are too long the cows drop their dung on to the floor, and when they lie down are almost sure to soil their hindquarters or udder. Under such conditions the labour necessary to keep the stalls and cows reasonably clean is much increased.

For the smaller cows, each double stall should be from 6 ft. 3 in. to 6 ft. 9 in. wide, and for the larger ones, from 7 ft. to 7 ft. 6 in. If the stalls are too narrow the cows tread on each other's legs, udder, and teats, and injury to the two latter almost invariably means loss of a quarter. If the stalls are too wide, the cows turn round in them, and drop urine or excrement in the trough, or on the floor of the stall.

Stall Divisions.—It is usual to stall the animals in pairs. The principal advantage of introducing divisions is that they render the cows less liable to disturbance, and prevent them from turning round and fouling their bed.

The stall divisions may be made of cement concrete, stone, wood, or iron. Wood is most generally used. The divisions should be of simple style to facilitate repairs. An illustration of a stall division is given in Fig. 2. A post 4 ft. 6 in. high, called the headpost, is placed close against the front of the manger, and another 4 ft. high, called the heelpost, 4 ft. 6 in. to the rear of it. Into these are mortised top and bottom rails for receiving the boarding, which is nailed upon one side only. A slighter post is placed at the back of the manger, in the feeding passage, to receive two short rails taking that section of the boarding which continues over the manger; the division extends to the bottom of the manger if a continuous feeding trough is formed. Occasionally the divisions are made with four rails instead of boards; this arrangement answers well and promotes the free circulation of air. The headpost by the feeding trough serves for tying up a cow on each side. Two ¾-in. iron rods 2 ft. long, are bolted through the post, to these iron rings are attached for sliding up and down. The neck chains of the cows are affixed to the rings.

During recent years hygienic considerations have led to the use of galvanised steel tubular divisions and stanchions in the equipment of the cow-house. It is claimed that the cows are kept clean, healthy, and comfortable under the

most sanitary conditions. The stanchions are hung on chains, allowing freedom for cows to lie down comfortably. They ensure cleanliness by keeping the cows in place—"forward" when lying down—"back" when standing. The cows have no weight to carry, and have perfect freedom for the neck. These sanitary cow-house fittings are sold by several manufacturers.

Troughs.—A feeding trough formed in cement concrete, and running the length of all the standings, is cheaper than any good form of separate trough; it can be more easily cleaned out, and, if supplied with a water-tap at one end and a waste outlet at the other, it makes an effective water-trough as well. The chief objection to the continuous trough is that tuberculosis may be conveyed from an affected to a healthy animal by the saliva of the former being carried down the trough.

In many districts a separate trough for each animal is preferred. These consist frequently of half-pipes set in concrete, with cement coping, or are constructed of brown glazed earthenware blocks. Where separate troughs are used water may be supplied in small circular troughs 9 in. or so in diameter, set in a recess cut out of the stall division, close to the wall or feeding-passage division, and about 1 ft. above the trough. These water-troughs should have a balanced lid which is hinged at the back and projects over the edge ½ an in. or thereabouts, and is so arranged that it cannot be lifted quite up to a perpendicular position. All stock seem to learn to lift the lid with their nose in a few days, and as soon as they have satisfied their thirst, the lid falls and keeps out dust, straw, &c. The level of the water in the troughs may be automatically regulated by a ball cock.

Manure Channel.—Probably no part of the average cow-house is constructed in so faulty a manner as the manure channel. In no case should it be less than 16 in. wide, and in erecting new cow-houses a width of not less than 24 in. should be allowed. It need not be of greater depth than 6 in. at the cow's heels, and at the side next the passage 4 in. will be quite enough. The channel should have a fall of 1½ in. towards the gangway, and a semi-circular channel for the liquid formed at the back about 3 in. wide, as shown in C., Fig. 4. It is undesirable to give more than 2 to 3 in. of fall from the feeding trough to the channel. A fall of ½ an in. per yard run in the length of the channel is sufficient. If the channel is any narrower than suggested it may quickly become blocked with manure, and the urine collect between each heap of manure, the result being that when a cow lies down her tail may drop into the pool of urine; under such conditions milk is almost certain to be contaminated.

Air and Floor Space.

Floor Space.—The provision of sufficient floor space is of great importance. When the floor space per cow is insufficient the operations of feeding and milking and the removal of the manure are hampered, while it is more difficult to ensure clean milk. Although the actual area required by a cow for her comfort is regulated by her size, it is unnecessary to consider the size of the individual cow in determining the total area required. With passages of the width suggested for the different designs of cow-houses, a floor space of not less than 45 square feet will be provided per cow.

Cubic Space.—Opinions as to the suitability or unsuitability of a cow-house from a sanitary point of view are frequently based on the amount of cubic space provided. This is due to the idea that in a building with a large cubic space the air remains approximately pure much longer than where the cubic space is smaller. Where buildings are occupied for a comparatively limited time, the inference is reasonably sound, but when applied to the case of a cow-house in which the animals are constantly stalled for half the year it is open to criticism. In the one case the building is frequently flushed with fresh air, whilst in the other this is only possible on rare occasions. Still, even in relatively large cow-houses, the air reaches a high degree of impurity shortly after the building becomes occupied, unless provision is made for ample ventilation.

This was strikingly brought out in the experiments carried out by the Highland and Agricultural Society during the winter of 1908 and 1909*. These experiments showed that there is no substantial gain in purity of the air, in buildings of very large cubic capacity per cow compared with those of more moderate size, and that if any cow-house, no matter what its cubic space per cow, is kept at a temperature of 60° F. or more, its air will contain about three times as much carbon dioxide as if the building were freely ventilated and kept at under 50° F. While the production of milk may be as great in the one case as in the other, the health of the animals in a freely ventilated small building will be better than of those in a larger but poorly ventilated building.

The cow-house must comply with the requirements as to floor area or cubic space laid down by any regulations adopted by the local authority under the Dairies, Cowsheds and Milk Shops Order. The usual minimum space prescribed is 800 cubic ft. per cow in cases where the cows are constantly kept and fed in the building, and 600 cubic ft.

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* See *Journal of the Board of Agriculture*, Oct., 1909, pp. 550–552.

where they are habitually turned out for at least part of the day. In reckoning the cubic space it is usual to leave out of consideration anything above 12 ft. in height from the floor. This is perhaps not unreasonable with the ordinary type of roof, in which there may be a zone of more or less stagnant air.

Ventilation.

Closely associated with cubic space, but in reality quite distinct, is the question of ventilation. While a certain floor and cubic space must be provided before the cows can be conveniently and economically attended to, the health of the animals and purity of the milk will depend to a great extent on the means provided for ventilating the building. Special systems of ventilation are by no means essential. Openings in the walls to serve as inlets for the air, and similar openings in the roof to serve as outlets will be quite effective, provided they are sufficient in number and size. Apart from windows the area of inlets should not be less than 40 sq. in. per cow: the area should be larger if the situation is at all sheltered. It does not follow that all available ventilation should be always made use of, but sufficient openings should exist to keep the air fresh, when the stock are in, and the air is calm. These openings should be provided with some arrangement by which the inlet of air can be easily regulated to suit the conditions of the weather.

The arrangements for the effective ventilation of cow-houses may be of the most simple kind. Air may be admitted by ventilating gratings, or drain pipes built in the wall about 5½ or 6 ft. from the floor. Windows constructed of the hopper, louvre, or hit-and-miss slide types will also be of great assistance in providing ventilation. Perhaps the most satisfactory window for a cow-house is the hopper type, (*see* A. and B. in Fig. 4). With this type draughts are prevented, and if the cows face outward, they get the benefit of the fresh air, while the odour and steam from the manure passes behind them and rises to the ventilating ridge. The best position for air outlets is admittedly the apex of the roof; simply and economically attained by raising any desired number of ridge tiles, superimposed and bedded upon the adjoining ones.

This will be ample for tile roofs, whether plain or pan-tiled, and in most cases will also suffice for slate coverings.

Small and frequent openings in the roof are preferable to large outlets, as the down draughts are less, and the fresh air is distributed more thoroughly where the outlets are smaller individually than the inlets, but greater in their collective area.

Light.

The lighting of cow houses is a matter of no little importance. Good lighting is essential for clean milking. Moreover, sunlight is one of the most powerful germicides, and should, therefore, be admitted freely into all buildings occupied by stock.

The simplest and cheapest means of lighting is to use a number of glass pantiles or slates in the roof, but the light from this source should be supplemented by that obtained from the upper part of any windows in the walls.

In estimating the total lighting area required for a cow-house 3 sq. ft. should be allowed for each cow.

Whitehall Place, London, S.W.,
September, 1911.
Revised, August, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 242.

BOARD OF AGRICULTURE AND FISHERIES.

Bacteriosis of the Potato and Tomato.

The disease termed bacteriosis of the potato and tomato has been known for some time in the United States, where it has been carefully studied by Dr. Erwin F. Smith. The organism concerned is called *Bacillus solanacearum*, E. F. Smith. Potatoes, tomatoes, and egg-plants are attacked, sometimes on a large scale, in America. In Great Britain the disease was first observed in 1902 in small quantity on potatoes grown in the North of England and in Scotland. During 1910 it attacked tomatoes to a somewhat serious extent, examples having been received at Kew from two localities, where it was stated to be present in an epidemic condition.

Description.

Tomatoes.—The symptoms indicating the presence of the disease on tomatoes are well marked. Infection usually takes place at or near the tip of the stem, the disease gradually working downwards, passing into the leaves and flowering shoots as it does so, until the root is reached. Shortly after infection the uppermost leaves commence to wilt, curl up, and turn yellow. The leaves become marked with many rather small, scattered, blackish-brown blotches, and long dark-brown streaks appear on the surface of the stem. If the stem be cut across, the vascular bundles or woody portions present a brown appearance, and on microscopic examination the vessels are found to be teeming with bacteria. The fruit also becomes more or less covered with dark-coloured blotches, which at first are quite superficial, but gradually increase in size and assume a watery consistence, finally collapsing and forming irregular pits on the surface of the fruit (*see illustration*). After the spots on the fruit, which are at first crowded with bacteria, have collapsed, various kinds of fungi and bacteria gain an entrance through the broken fruit, which is speedily reduced to pulp. Diseased plants gradually droop and die from the top downwards.

Potatoes.—In potatoes the symptoms are somewhat similar to those described above. The uppermost leaves droop first, and the stem becomes very conspicuously marked with blackish longitudinal streaks. The vascular bundles are also browned, owing to the presence of the bacteria, which travel along the vessels of the underground branches and pass into the tubers, where their presence is indicated by a more or

less decided brown ring situated a small distance from the outside of the tuber, and corresponding to the position of the vascular-bundle ring of the tuber. As an infected tuber increases in size the bacteria encroach on the central mass enclosed by the vascular ring; the central mass then gradually assumes a brown colour, and finally becomes soft and rotten, leaving a thin outside crust intact. This shell is usually broken when the potatoes are lifted, and its contents, swarming with bacteria, remain in the land.

Preventive and Remedial Measures.

1.—Bacteria have occurred abundantly in the substance of partly ripe tomatoes; hence, owing to the difficulty experienced in thoroughly removing the glairy coating from the seed, it is highly probable that bacteria would become locked up in this substance as it dried round the seed, and on being released during germination would endanger the crop. Seed obtained from fruit grown in an infected area should therefore not be used.

2.—In the case of potatoes, Dr. Smith has shown that the rapid spread of the disease is caused by insects of various kinds, which feed alternately on diseased and healthy plants. The numerous isolated patches of disease on the fruit and leaves of the tomatoes examined at Kew support this view. To prevent this the plants should be sprayed with Bordeaux mixture *containing an insecticide*, such as Paris green, which would answer the double purpose of warding off insects and preventing the appearance of *Phytophthora infestans*, *Cladosporium fulvum*, and other pests. A suitable mixture for the purpose may be made as follows :—

Paris Green and Bordeaux Mixture.

Quicklime	10 lb.
Bluestone (copper sulphate)	10 lb.
Paris green	8 ozs.
Water	100 gallons.

Mix the Paris green into a paste with a little warm water, then add to the Bordeaux mixture, and stir thoroughly.

3.—Potato tubers showing the slightest trace of an internal brown ring should not be used for "sets."

4.—Soil that has produced a diseased crop should be treated with superphosphate of lime.

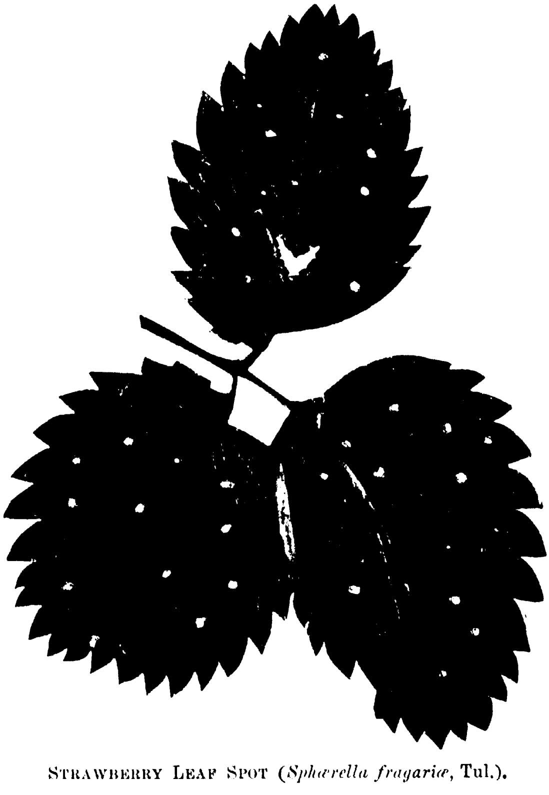
Whitehall Place, London, S.W.,
June, 1911.
Revised, October, 1913.

BACTERIOSIS OF TOMATO PLANT (*Bacillus solanacearum*).

Leaflet No. 243.

BOARD OF AGRICULTURE AND FISHERIES.

Strawberry Leaf Spot (*Sphærella fragariæ*, Tul.).



STRAWBERRY LEAF SPOT (*Sphærella fragariæ*, Tul.).

Both cultivated and wild strawberries are often severely injured by a fungus called *Sphærella fragariæ*, Tul., better known in this country as *Ramularia Tulasnei*, Rab., a conidial form of the *Sphærella*, and for a long time the only known condition of the fungus. The foliage is the part attacked, and the symptoms are unmistakable. Small reddish-brown spots appear on the leaves; these often encroach on each other and form irregular patches. By degrees the centre of each patch assumes an ashy-grey or whitish colour, bounded by a reddish border, which becomes bright red later in the season. This peculiar arrangement of

a whitish spot bounded by a red ring has given origin to the local name of "Birds' Eye Spot" in some parts of the country (see figure). The central whitish portion of the patch soon becomes studded with minute tufts of the conidial or *Ramularia* condition of the fungus. These continue to infect healthy leaves throughout the season. When the infected leaves begin to languish, the conidial condition is followed by the higher or *Sphærella* condition of the fungus, the spores of which remain on the dead leaves until the following spring, when they are liberated and infect the young leaves.

This pest is everywhere present in this country, and is also well known on the Continent and in the United States. None of the cultivated varieties escape the disease, but some are more severely attacked than others. The variety called "Royal Sovereign" is especially susceptible to the disease. When the injury is severe the crop of fruit is much reduced both in quantity and in quality; the plants are also weakened for the following season.

If spraying is commenced at a sufficiently early stage (in fact, where the disease has previously existed spraying should commence when the leaves are quite young) an epidemic may be prevented. The plants should be sprayed with a solution of potassium sulphide (liver of sulphur) in the proportion of one ounce to three gallons of water, or with Bordeaux mixture (10 lb. of sulphate of copper and 8 to 10 lb. of lime in 100 gallons of water). This treatment will also arrest the possible appearance of Strawberry Mildew, *Sphærotheca humuli*, Burr. Spraying should be continued at intervals until the flowers begin to open.

The following method of combating the disease has proved highly satisfactory when strawberry beds are badly infected. The beds should be mown soon after the fruit is gathered, covering the dry leaves with a sprinkling of straw or dry litter and burning them. This may seem harsh treatment for the plants, but everyone who has tried burning over a strawberry bed has been surprised by the vigorous and healthy appearance of the new foliage.

NOTE.—This disease is also referred to in Leaflet No. 207 (*Strawberry Cultivation*), which further deals with Strawberry Mildew (*Sphærotheca castagnei*, Lév. = *S. humuli*, Burr.), and certain insect pests of the strawberry.

Whitehall Place, London, S.W.,
December, 1910.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 244.

BOARD OF AGRICULTURE AND FISHERIES.

The Destruction of Rats.

Two kinds of rats are found in Great Britain, the Black Rat (*Mus rattus*), and the Brown Rat, sometimes called the Hanoverian or the Sewer Rat (*Mus decumanus*). The former, which has been longer established in this country, is the smaller of the two. It is more lightly built, but its ears are slightly larger and it has a thin tail eight or nine inches long, or about an inch longer than the rest of its body. The upper part of its fur is of a grey black colour, the under parts being a dark grey. The brown rat is generally longer in the body, but shorter in the tail, which is never as long as the head and body combined. It has a blunter muzzle, and its fur is grey-brown above and white below. The fur of the brown rat, moreover, is rather coarser than that of the black rat.

The females of both species breed at a very early age, and though they go with young for six weeks they have several litters in the year, each litter comprising from six to fourteen young. Rats therefore increase in numbers very rapidly if sufficient food is available. It has been calculated that in India, where they breed all the year round, the offspring of a single pair would, if supplied with sufficient food and left unchecked, amount at the end of one year to thirty-five thousand. Fortunately such favourable conditions are never present.

Damage done by Rats.

Rats are omnivorous feeders, and when desperate with hunger are even cannibals, but they are by choice dependent on the food supplies which man prepares for himself and his domestic animals, or on the waste of such food. Many estimates have been made of the damage done by the rat population of Great Britain in a single year, but as these estimates are based on the assumption that the supplies consumed by rats would otherwise be available for human use or consumption the reasoning is unsound. It is obvious, however, that the damage done is enormous. Rats frequent dwelling-houses (generally only the lower floors), barns, granaries, poultry yards, slaughter-houses, sewers, and other places where food supplies are stored, or the waste is thrown away. They also frequent rabbit warrens, and take to the fields when food is to be found there, returning to shelter and to breed in corn stacks in the autumn.

Apart from the food consumed by rats, much damage is done to buildings, floors, and all kinds of woodwork from their power of gnawing holes and passage ways. It is also

known that plague may be spread to human beings by fleas from infected rats. In a Memorandum on Bubonic Plague issued by the Local Government Board and based largely on the experience of the Indian Plague Commission it is stated that:—"Plague for administrative purposes may be regarded as a disease of rats which incidentally and occasionally attacks man. Fleas form the intermediaries between the diseased rat and man. If the fleas of infected rats (or the fleas of such other animals as occasionally suffer from plague) are excluded from access to human beings, plague will seldom, if ever, be spread from animals to man." (*See* note, p. 8.)

It is, therefore, highly desirable, both from an economic and a sanitary point of view, that rats should as far as possible be destroyed. It would, of course, be well if they could be entirely exterminated in Great Britain, but this is practically an impossibility.

Though, however, extermination must be considered impracticable, yet preventive measures may successfully be taken to minimise the damage done, while systematic and continued efforts to reduce the number of rats will certainly not be without effect.

Preventive Measures.

A number of measures may be adopted to prevent damage by rats, and by cutting off a liberal supply of food to discourage their presence and prolific breeding. Among these measures may be mentioned:—

(*a.*) Building ricks and granaries on rat-proof piles;

(*b.*) Rendering buildings as rat-proof as possible by means of concreted foundations, brick-work laid in cement, and galvanised iron sheeting;

(*c.*) The use of concrete or metal grain and meal bins in stables and elsewhere, and covering the angles of wooden receptacles already in use with tin sheeting;

(*d.*) Proper construction, protection and repair of drain pipes, ventilators, and basement windows, so as to make each dwelling or building as far as possible rat-proof;

(*e.*) The disposal of garbage, refuse and waste food, so that it is not available for rats: this is particularly important on the farm, in slaughter-houses, and in factories;

(*f.*) The protection of the natural enemies of rats.

As regards (*a*), rat-proof piles may consist of stone piers surrounded by a wide inverted pan or saucer-shaped rim of tin sheeting; the piers should be 3 to 3½ feet high, with the protective rim near the top.

Floors of farm buildings may be of concrete or be laid directly on concrete.

Basement windows, wooden bins and similar receptacles, may be protected by a covering of heavy galvanised wire netting of one-half inch mesh. The lower parts of the doors of farm buildings may usefully be covered with thin metal sheeting.

Garbage and refuse of all kinds which might form food for rats should be burnt or otherwise disposed of. Waste food should not be left in stables, cow-houses or poultry runs. This is a point to which great attention should be paid, as food left about in this way forms one of the principal attractions to rats in farm buildings and stables. *It should be recognised that the existence of rats is strictly dependent on the food they are able to obtain and that they will not remain or increase in places where food is not easily procured.*

Rubbish heaps, and all places which may afford shelter for rats to breed, should be cleared away. Stores of old materials should be frequently moved and examined, and kept thoroughly clean and tidy. Receptacles for refuse should be covered, and preferably constructed of metal.

Burrows from which rats have been driven should be filled with concrete, a mixture of cement, sand, and broken glass or crockery, or a mixture of broken glass and tar.

The *natural enemies of rats* are numerous, and in considering the prevalence of rats these enemies are deserving of every recognition. Owls, hawks, buzzards, rooks, crows, ravens, sea-gulls, stoats, weasels, and foxes are all well-known enemies of rats, mice and voles. Cases showing the proclivity of owls for rats are numerous; it will suffice to mention one instance, in which Seebohm states that 20 freshly-killed rats were found in the nest of a Barn Owl. The wanton destruction of many of the birds mentioned above is strongly to be deprecated.

It is, perhaps, hardly reasonable to expect that stoats should be allowed to multiply in game-coverts, or in the vicinity of pheasant coops, but the Board have no hesitation in recommending that weasels, which are persistent and inveterate enemies of rats, mice and voles, and do little damage to game, should not be molested, unless there is direct evidence that they are present in undue numbers.

Remedial Measures.

There are three methods which may be employed in the destruction of rats:—(1) *Hunting*; (2) *Trapping*; (3) *The use of poisons, rat virus, or fumigation.*

(1) There is not much to be said about the first of these methods. Most residents in the country are acquainted with the ratting instinct of terriers, and with the employment of ferrets, and a knowledge of the practice can better be obtained by experience than by description. Ferrets are employed to cause the rats to bolt from their burrows to

be killed by dogs, sticks, and the use of the shot gun. When corn ricks are threshed a special endeavour should be made to kill every rat which is turned out; most of the vermin will be found towards the bottom of the rick, and many scores are often accounted for when the bottom of an old rick is reached.

This method may be made more effective by surrounding the ricks, before thrashing is commenced, by a galvanised iron fence or by wire netting 4 feet in height and slightly sloping towards the ricks. Rats, although they may be able to run or climb up this netting, cannot jump over it and may be killed by dogs, sticks, &c. Galvanised iron is to be preferred to wire netting for this purpose where available. This idea has been recently tried in Suffolk with much success.

In stack yards and other places where rats abound they can be attracted into the open at night by any powerful light such as that from an acetylene or motor lamp and then killed by sticks, &c.

(2) As regards traps, many types are employed with success. These include the spring trap which kills the rat at once when the spring is released, after the manner of a guillotine; the ordinary steel gin or toothed spring traps, which, however, may not only prove a source of cruelty, owing to rats being left in them for hours, but are unsatisfactory in another way, because the squealing of the animal in the trap gives warning to other rats; the wire trap, on the eel-basket principle, which the rat can enter easily when attracted by the bait but cannot leave; sunk pit or well traps; and the large barrel traps with slit paper or hinged wooden covers.

Pit traps consist of stout boxes let into the ground in the line of the rat runs, the top being level with the surface and covered by a light metal or wooden lid in two sections, each of which swings easily on a rod and is weighted near the outside edge. Any rat passing along the run and on to the cover of the box falls into the box, the cover at once swinging again into its normal position. Baits may be fixed to the swing covers towards the centre.

A barrel trap may be made by covering the top of a large barrel with a sheet of stout brown paper securely fastened to the outside of the barrel. On this rats may be fed for a night or two, pieces of wood leaning against the barrel affording them ready access to the top. Thereafter the paper is slit in the form of a cross and the bait fixed to the four portions. (The slit, of course, should not be continued to the edge of the barrel.) Rats now going forward for the bait will be precipitated into the barrel. The cover may also take the form of a wooden lid swinging on a pivot across the centre, so that it will turn with the weight of a rat. A stop

should be fixed on the barrel edge on one side, to prevent continued swinging of the cover after a rat has been thrown into the barrel, and the bait should be fixed to the other half. In some districts it is the practice to place a brick on end at the bottom of the barrel which is then filled with water to the level of the top of the brick. In this way other rats than the one first precipitated into the barrel when seeking the bait may be attracted by the screams of the trapped rats and secured.

It should also always be borne in mind that the baits used for rats should be of a different type to the food the rats usually obtain, and that a change of bait is sure to be of value.

(3) *Rat poisons* are sold in all country towns by chemists, and several patent or proprietary poisons are advertised in agricultural and other newspapers. They are generally composed of phosphorus paste or arsenic, but strychnine may also be employed, while the use of barium carbonate has also been recommended.* Plaster of Paris is sometimes used

* A bulletin published by the United States Department of Agriculture discusses the relative merits of arsenic, phosphorus, strychnine and barium carbonate as rat poisons. *Arsenic* is cheap, and perhaps the most popular poison for the purpose, but experiment showed that, measured by the results obtained, it is dearer than strychnine. It is variable in its effects. One part of arsenious acid may be mixed with twelve parts by weight of oat or maize meal and made into stiff dough with white of egg. *Phosphorus* is almost as commonly used as arsenic, and is effective when mixed in an attractive bait; but in the paste forms, which contain from one to four per cent. of yellow phosphorus in glucose and other substances, the lower percentage is too small to be always effective, and the larger amount is dangerously inflammable. Many fires have been caused by phosphorus paste in the United States, and the Biological Survey does not recommend its use. It is said that there is no foundation in fact for the statement that phosphorus dries up or mummifies the body without odour when eaten by rats or mice. *Strychnine* may be effectively employed in the open and round farm buildings, but it is too rapid in its action for use in houses as the vermin would die on the premises. Dry crystals of strychnia sulphate may be inserted in portions of raw meat, sausage or fish, and these placed in the burrows. Strychnine syrup may be prepared by dissolving ½ oz. of the sulphate in one pint of boiling water and stirring in one pint of thick sugar syrup; this may be used to moisten a bait of oatmeal, while wheat or maize may also be soaked in it. In all cases it is advisable that baits containing one of the above poisons should be obtained ready prepared from a pharmaceutical chemist. *Barium carbonate* is considered one of the cheapest and most effective poisons for rats and mice. It is without taste or smell, has a corrosive action on the mucus lining of the stomach, and, causing thirst, induces the vermin to seek water in the open, where they die. Care should be taken not to place it where it can be taken by poultry, birds, dogs or cats; in the small doses used it is probably harmless to the larger domestic animals. It may be employed in the proportion of one part of the carbonate to four parts of meal, mixed to a dough with water. A convenient bait is composed of one part by measure of the mineral to eight parts of oatmeal, mixed to a stiff dough. The carbonate may also be spread on fish or moist toasted bread. In 1905 large quantities of a poisonous food were sent out by the Agricultural Botanical Institute at Munich for the purpose of destroying field mice, and it is stated that it chiefly contained barium carbonate.

mixed with flour, which sets into a hard mass in the rat's stomach. It must be remembered that rats are very suspicious, and if they find that any number of their fellows die after eating any kind of food they will avoid such food for some time. It will be as well, therefore, to vary the form and appearance of the poisoned bait at intervals. Thus, after using poisoned bread for a while, oatmeal similarly treated may be used.

Apart from the risk of a possible prosecution under the Acts which deal with the use of poisoned grain, meal, or meat, it is very necessary when using poisons to take precautions to avoid injury to other animals and human beings. (The Acts concerned are the Poisoned Grain Prohibition Act, 1863, and the Poisoned Flesh Prohibition Act, 1864.)

In any case poisoned baits should only be laid by authorised and responsible people. Their whereabouts should be carefully recorded, and they should be visited regularly and destroyed if not taken within a short period. The strictest precautions should be taken to prevent the bait being eaten by domestic animals, and if necessary notices should be exhibited in places where baits are laid to warn people to keep dogs or other animals away from the place. When poisoned baits are laid by a Rat Club or other organisation, it would be as well to insist that each group of baits should be numbered, and its situation, success, or failure and ultimate destruction recorded in a book.

Rat viruses, of which several on the market are stated not to entail direct injury to any animals other than rodents, are believed to be composed in every case of a culture of a microbe causing a specific disease of rats, which in some cases at any rate is contagious, so that the inoculated rat conveys the disease to his fellows. The uncertainty with which this method is attended is due partly to the difficulty of securing a successful infection in all cases, and partly to the fact that, if only slightly infected, rats recover and thereafter become more or less immune to the disease.

The warning as to the use of poisoned baits applies equally to the employment of rat viruses, and it is important to avoid contamination by the virus of any material likely to be used for food.*

Fumigation may also be resorted to in order to destroy rats, but it is inadvisable in the case of dwelling-houses, and must be employed with great care wherever food is stored. In the case of warehouses and stores hydrocyanic acid gas is perhaps the best agent, but the danger to human life only

* An outbreak of enteritis among the employers of a large business establishment in London, attributed to the use of one of these viruses in the building, was reported on by Drs. Harrison, Williams and Klein in 1909.

warrants its use under careful instruction. For an account of Fumigation with Hydrocyanic Gas, Leaflet No. 188 should be consulted. For burrows in the open—hedgerows, banks, open sheds—carbon bisulphide may be employed. A large wad of cotton wool, rags or similar absorptive material should be soaked with the liquid, at once inserted in one of the main burrows, and the outlets and inlets closed up. The liquid evaporates, permeates through the burrows and asphyxiates the rats.

Care should, however, be taken in using the bisulphide as it is both poisonous and highly inflammable. For fumigation purposes on ships and in houses sulphur dioxide is less dangerous, owing to the smell of the gas emitted when the top of the cylinder containing the substance is removed, and the irritation caused by the gas to the air passages. Formaldehyde may also be used for this purpose.

Need for Combined Effort.

The destruction of rats is essentially a matter for local effort, but local effort does not necessarily mean isolated or unsystematic effort. In many places it is true that rats can be kept down by cats, traps, and occasional rat hunts, and this is the case in most dwelling-houses, especially if the kitchen and outhouses are kept in a clean and tidy state so that the rats find it difficult to procure an abundance of food. It is also true of many farms where the buildings are well kept, but in other cases on farms, or in mills, malt-houses, and other establishments where large supplies of food are stored, especially where several such buildings stand close together, combined effort is essential.

In such cases, it is obvious that it is useless to attempt to clear one building or farm, while leaving it exposed to immediate re-invasion from adjoining premises. The occupiers of a group of farms or buildings should therefore join together with a view to a systematic attempt to *exterminate* the rats over as large an area as can be conveniently dealt with.

For this purpose, reliance should not be placed in any one of the methods referred to above, but as far as is possible *all these methods should be employed.* A combined effort should be made simultaneously, the attack in each instance commencing on the boundary and working gradually towards a central spot, such as a group of ricks, where it is considered that the final work of destruction can be accomplished with least difficulty. Rat hunts should be organised all round the boundary of the area, and traps and poison should be laid on the outside. Every precaution should be taken to see that no rats escape outwards. Their holes should be closed, and their runs and nests destroyed as the cordon is gradually drawn closer.

In the case of large districts, a number of adjoining areas such as that described above might usefully be mapped out and dealt with simultaneously.

A somewhat similar system which is frequently adopted consists in the formation of a Rat Club as described in Leaflet 84. By means of small subscriptions from farmers and landowners, a fund is provided out of which prize money is paid in proportion to the number of rats caught by the members, who are usually agricultural labourers. In the case of one club in Kent with less than 20 working members it is stated that some 16,000 rats were destroyed in the course of three seasons.

This system, though it does not secure the extermination of the rats in a district, is a useful means of keeping them in check at a relatively small expense.

NOTE.—Owing to the connection of rats with the distribution of plague the Local Government Board on November 10th, 1910, made certain Regulations providing for the destruction of rats by Local Authorities in England and Wales. Article 2 of these Regulations provides that in any district in which a representation is made to the Local Authority that rats in the district are infected or threatened with Plague, or that there is an unusual mortality among rats in the district, the Local Authority shall report the matter to the Local Government Board and shall take measures (*a*) for the destruction of all rats in the district, and (*b*) for preventing the entrance of rats into buildings and other premises in the district.

Whitehall Place, London, S.W.,
December, 1910.
Revised, March, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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Leaflet No. 245.

BOARD OF AGRICULTURE AND FISHERIES.

Crown-Gall.

The presence of galls or tumour-like outgrowths on the roots of plants of various kinds, has long been known, both in this country and on the Continent, perhaps more especially on vine roots. When they are old such galls become hard and woody, and indicate no trace of their origin, and this accounts for the generally accepted opinion, in the absence of any parasitic organism at that stage, that the primary cause of such galls is due to wounds, frost, or to some physiological disturbance.

Quite recently the occurrence of galls in every stage of development, on the roots of the Paris daisy (*Chrysanthemum frutescens*, L.), admitted of a thorough investigation of the subject, and showed clearly that the galls were identical with the well-known and very destructive disease called "Crown-Gall" in the United States. Specimens of similar galls on plum, rose, raspberry and loganberry have recently been sent to Kew. In the United States the following plants are attacked in addition to those mentioned above:—Peach, apricot, almond, prune, apple, cherry, poplar, chestnut, and blackberry. There is at present no direct knowledge as to the relative frequency of crown-gall in this country, but judging from the literature relating to plant diseases, galls answering to crown-gall are far from uncommon in every country where fruit trees are grown.

Crown-gall is very destructive to nursery stock, as the disease spreads rapidly along the rows, killing a large number of seedlings outright. When older trees become infected, the galls may continue to be produced for many years, the trees living on, but making less growth and producing a smaller quantity of fruit which is of an inferior quality to that of a healthy tree. Under such circumstances it is false economy to allow such trees to remain standing.

The galls are usually formed just under ground on the collar or root, and so escape observation. They commence growth as minute, wart-like bodies; growth is rapid, and the surface of the gall becomes coarsely warted and dark coloured, and varies in size from two to three inches in diameter to that of a football, or, even larger. The galls

Crown Gall on Collar of Paris Daisy (*Chrysanthemum frutescens*).

usually decay at the end of one season's growth, and leave an open wound, which penetrates for some distance into the wood. The following season gall growth commences round the edge of the wound formed in the previous season. These galls perish in turn, and the process is repeated each season, resulting in a large, deep wound. When two or three such wounds are present on different sides of the collar, the tree usually breaks off at the wounded part.

Two distinct organisms have been found to occur in the tissues of the galls, but a bacterium, *Bacillus tumefaciens*, has been proved, in America, to be the primary cause of the disease.

As crown-gall is caused by a parasite and is highly contagious, measures should be taken to prevent the dispersion of the disease on the part of nurserymen and fruit growers.

Its wide-spread dissemination in the fruit-growing regions of the United States is attributed to the wholesale distribution of infected stock from nurseries, and to negligence in the disposal of diseased material.

Badly diseased trees should be removed, and the galls along with the wood in their vicinity should be burned at once. When trees are only slightly diseased, the galls should be cut away, and the wounds covered with a paste composed of two parts of sulphate of copper (bluestone), one part of sulphate of iron, and three parts of quicklime.

Quicklime should be worked into the soil in orchards known to be infected.

Whitehall Place, London, S.W.,

June, 1911.

Copies of this Leaflet may be obtained, free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Prevention of Damage to Hides, Skins, and Wool.

Among the most important live stock products, after the meat itself, are the hides of cattle and the wool and skin of sheep. These are, it is true, bye-products in the sense that the animals are primarily grown for meat and not for their hides or skins, but they are bye-products of very considerable value, and as such deserve more attention at the hands of farmers and others interested in the live-stock industry than they commonly receive.

The value of these bye-products is frequently depreciated by causes which are recognized as injurious in other ways, but which are not usually regarded as necessarily affecting the price which the farmer receives for his stock and produce. Representations made to the Board by the various industries concerned, however, have shown that the loss in value thus caused is a serious matter, and that it does directly affect the farmer as the producer of the raw material.

*The Warble Fly.**

One of the most harmful insect pests in this country is the Warble Fly, which is injurious to living cattle, to the hides, and to the meat. Though the flies do not sting or pierce the skin, it is believed by some investigators that they have a peculiarly irritating effect on stock, and that when tormented by them, cattle will rush wildly about the fields in their endeavour to avoid the flies. Careful observations made in Ireland showed that cattle and particularly calves were extremely sensitive to the approach of the Warble Fly. In the case of fattening animals, this would occasion a loss of weight, while it would be still more injurious to cows by diminishing the supply of milk. With in-calf cows abortion might follow as a result of the excitement and exertion.

The maggots or bots living beneath the skin are also a source of irritation to the cattle, and the perforation of the hide seriously reduces its value for tanning purposes. Thirdly, the meat round the wounds is frequently so altered by the inflammation set up that it is quite unfit for sale. When the hide is stripped from a carcass, the affected parts appear as straw-coloured, jelly-like patches on the surface of the meat. This is known in the trade as "licked beef," and it has to be entirely cut away, thus causing substantial loss, especially as it is usually found in the most valuable parts.

* *See also* Leaflet No. 21 (*Warble Flies*).

Various estimates have been made from time to time of the loss caused by the Warble Fly, but there are no reliable data on which an opinion can be formed. As an example of the comparative prevalence of the fly it may be mentioned that the Board were recently informed that in the case of a tannery where 132,000 hides were dealt with in one year, 40,000 of these were found to be damaged by Warble Fly, though in another case only 1,500 out of 20,000 were affected. The depreciation in value as a result of the damage was from 2*s*. 6*d*. to 5*s*. per hide.

A point of considerable importance to the tanning industry is that the warbles, when in an immature state, cannot easily be observed under the hide, and this makes it difficult to fix a fair price.

Generally it may be said that this insect in its various stages must be the cause of a good deal of suffering which, from a humane point of view, it is desirable should be diminished, while it must also occasion serious loss through the affected cattle not thriving so well as under normal conditions.

It is evident that in the majority of cases the farmer is the only one who can do anything to minimise the injury, and every farmer should make a systematic attempt to eradicate the insects.

Thorough and systematic destruction of all warble maggots by farmers each year from February to the end of April would in a year or two so reduce the numbers of the warble flies that they would no longer be a pest. If such a plan were carried out, even in one particular district, the fly might be got rid of, though cattle imported from another part might re-introduce it, and would have to be carefully examined and treated every year.

All stock should be frequently examined during winter and spring, especially from February to April, and the maggots extracted from the warbles and destroyed.

The maggots, when "ripe," may be extracted by squeezing the warbles with both thumbs, and may then be crushed; this process is most easily carried out in wet weather. This is a better plan than covering the opening of the warble with grease or mercurial ointment, so as to suffocate the bot within. Alternatively a small amount of arsenic in solution may be inserted into the warble, to destroy the maggot. The use of equal parts of Archangel tar and paraffin has also proved successful in Ireland as a means of destroying the warble under the skin. In the case of cattle treated with this mixture, all the warble maggots were found to be dead or shrivelled, and in many cases at least were being worked out of their holes, so that injury to the hide

and flesh was reduced to a minimum, while the application did not appear to damage the animal's skin and hair. The mixture should be applied thoroughly at least twice in the season, about the middle or end of April and at the end of May.

If the practice of destroying the maggots be systematically followed, it must result in an appreciable reduction in the number of adult flies. Consequently fewer eggs will be laid to produce maggots in the following season. The method has been tested in the course of some experiments carried out for the Irish Department of Agriculture and Technical Instruction by Messrs. Carpenter and Steen, and seemed to result in a substantial local reduction in the prevalence of the fly. In 1907, 2,090 maggots were squeezed out of 194 cattle on the farm where the investigation was being conducted, an average of 10·77 per beast. In the spring of 1908, 132 of these cattle were still on the farm, and had been left throughout the summer of 1907 without any kind of dressing or protection against the fly. From these cattle 586 maggots were squeezed out, an average of 4·44 per beast, and this reduction was thought to be due to the destruction in the previous year. In 1909, however, the proportion rose to 7·77, while in 1910 it was 7·52. The conclusion arrived at is that systematic maggot destruction in the spring will reduce the liability of the cattle to attack to a certain extent, but that the benefit will be limited until similar steps for the destruction of the maggots are taken on neighbouring farms. This is possibly the reason why the cattle grazing on the outskirts of the farm suffered much more than those near the centre of the farm.

The Board would suggest that Agricultural Societies and Farmers' Clubs should urge their members to adopt the plan of removing and destroying the maggots, it being certain in its results, and more effective than the use of strong-smelling dressings with the idea of deterring the flies from laying their eggs. The use of these dressings, though they have long been recommended, appears in the light of recent investigations to be of more than doubtful efficacy. Ostertag, a German authority, has stated that no case was known to him where good results had been attained by it.

Damage to Hides owing to Dirty Condition of Animals.

The value of the hides of cattle is also materially affected if the animals are allowed to get into a dirty condition. Farmers, though they may recognise the importance of cleanliness in the case of dairy cows, seldom make any effort to keep fattening cattle clean, with the result that dung and dirt accumulate, particularly on the buttocks. This spoils the hair and makes the grain of the hide tender, with the result that

the quality of the leather is depreciated. In addition it affects the cleanliness of the meat after slaughter.

It is desirable that fat stock should be groomed from time to time in order to encourage the growth of hair and preserve the condition of the hide.

*The Branding of Sheep.**

The practice of branding the sheep with tar or paint is one which results in damage to the wool, even when these materials are used sparingly, and when every care to avoid "smearing the brand" is taken. Sheep are usually branded immediately after being shorn, and that is the proper time. To brand later, when the wool has attained to a fair length, is a most reprehensible practice, because so much more of the tar or paint remains upon the fleece until the time of shearing.

All tar and paint marks have to be clipped off, and this reduces the length of the wool-staple, and consequently depreciates its value.

It has been estimated that the loss sustained by the users of wool in Bradford and district, under present branding conditions, is not less then £100,000 per annum. This is apart from the numberless claims that arise for damaged piece-goods, owing to some small portions of the tar or paint having escaped observation in the processes prior to the dyeing of the cloth.

As tar and paint are not dissolved in any process of wool-washing, flockmasters should endeavour, in cases where their use cannot be avoided, to improve the methods of applying them, either by making use of smaller marks or by adopting means to prevent the tar or paint from running or being smeared.

Where practicable, marking on the ear or face is much to be preferred.

Another point in this connection is the risk that the iron and the tar, with which the branding is done, may be made too hot, and penetrate through the wool to the skin, causing severe suffering to the sheep, and at the same time reducing the value of the skin for tanning purposes. The inquiries which the Board have made lead them to believe that this only occurs in a limited number of cases through gross carelessness, but it is a point which farmers would do well to bear in mind.

In some districts of Scotland sheep are sometimes branded with a hot iron across the nose or cheek. This is a cruel practice, and should be discontinued.

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* *See also* Leaflet No. 82 (*Preparation of Wool for Market*).

Injury to the Wool and Skins of Sheep by Various Parasites.

The injury due to the parasite causing sheep-scab is well known.* In their endeavour to allay the irritation caused by the mite, the sheep constantly bite or rub the affected part; this results in injury to the skin, followed by an exudation of serum and the formation of crusts or scabs. The wool is shed, and the fleece becomes broken and tufted or matted together, giving the animal a ragged appearance. With a view to the eradication of this disease the Board have made sheep-dipping compulsory, and with the earnest co-operation of all concerned there is reason to hope that their efforts will be successful in the course of a few years.

Several other sheep parasites, such as keds, ticks and lice, as well as the maggots of the sheep maggot-fly, also cause serious injury to the skin and wool in a somewhat similar way.

Broadly speaking, sheep dips are more or less effective against the first three of these parasites. For the destruction of keds, two dippings at intervals of three weeks are necessary; for ticks arsenical dips appear to give the most satisfactory results; while any dip which is suitable for sheep-scab is effective also against lice.

Full information as regards sheep-scab is given in Leaflet 61, while the general subject of sheep-dipping, both for sheep scab and for the destruction of other parasites, is dealt with in Leaflet No. 145.

Dipping is also useful against the larvae of the sheep maggot-fly, but is not permanently effective in preventing the flies from egg-laying or "striking." These maggots are the cause of much distress and suffering to the sheep, as well as of permanent injury to the wool and skin. The sheep consequently thrive badly, and the farmer loses by the depreciation in value both of the animal and of its fleece.

The measures recommended against this pest are fully described in Leaflet No. 126.

Risk of Injury to Skins by Sheep Dips.

Complaints have been made to the Board that, with a view to the eradication of sheep-scab, farmers occasionally use sheep dips at a greater strength than is recommended, with the result that the solution causes suffering to the sheep and injury to the wool and skin. This is not likely to occur where approved dips are used at the proper strength.

Experiments have shown that the use of strong arsenic or sulphur dips is attended with some danger when treating sheep affected with scab, especially if they are in low condition or have sores on them.

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* *See also* **Leaflet** No. 61 (*Sheep Scab*), and No. 145 (*Sheep Dipping*).

In the selection of dips, care should be taken to use only those that do not permanently stain the wool.

The results of experiments arranged by the Departmental Committee, appointed by the Board of Agriculture and Fisheries in April, 1903, to investigate and report upon the dipping and treatment of sheep, go to show that tar acid (carbolic) dips, and tobacco and arsenical dips, with or without sulphur, when skilfully prepared, leave the wool in a nice condition. Fleeces so treated were placed in the first class by the Bradford Conditioning .House, as not having deteriorated in value as a result of the dip. Pitch oil, spirits of tar, and crude tar products lowered the commercial value of the fleece by 5 or 10 per cent.

Flaying.

Hides and skins are often removed in a defective manner, the result being a lowering of their value. This is a matter of interest to butchers rather than farmers, and the only way in which an improvement is likely to be effected is through the action of some of the societies representing the industry.

In Ireland a number of demonstrations of the most approved methods of flaying hides and skins were given in 1908–9 by an expert flayer at the principal centres of the fresh meat trade and of the tanning industry in Ireland. The work was carried out through the co-operation of the Irish Tanners' Federation, who undertook, subject to the approval of the Irish Department of Agriculture, to employ a properly qualified flayer, to select the centres and to organise the demonstrations, the Department itself defraying the expenses. A similar series of demonstrations was given in 1905–6, and it is stated that the instruction was much appreciated, and that a lasting improvement in the methods of flaying is anticipated.

At Glasgow and at Newcastle the trade societies have endeavoured to some extent to encourage the men to become more skilled in flaying by offering prizes for proficiency, and this is said to have had satisfactory results.

Whitehall Place, London, S.W.,
March, 1911.

Revised, September, 1912.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 247.

BOARD OF AGRICULTURE AND FISHERIES.

Shot-hole Fungus (*Cercospora circumscissa*, Sacc.).

The parasite *Cercospora circumscissa* attacks the leaves of the peach, almond, cherry, apricot and nectarine. Less frequently the leaves of the plum and of other rosaceous trees are injured.

The first indication of the disease is the presence of small pale-green, translucent spots scattered over the blade of the leaf. These spots gradually become more clearly defined, and increase in size up to a diameter rarely exceeding one-sixth of an inch. When the patches commence to turn yellow, the fungus bursts through the epidermis of both sides of the leaf, in the form of very minute dark-coloured, hair-like tufts or threads which bear the minute spores at their tips. At this stage the diseased patches become dry and brown and drop out, leaving circular holes, suggesting the idea of the leaf having been riddled with small shot; hence the popular name of "shot-hole fungus" (*see illustration*).

The reason why the pieces drop out of the leaf is as follows:—The irritation caused by the fungus induces the formation of a circumscribing wall of wound-cork or periderm round the affected area, cutting off its supply of food; the isolated patch therefore dies, contracts and falls out, carrying along with it the fungus, which remains in the fallen patches until the following season, when a crop of spores is produced and infection of the young leaves takes place.

When the diseased patches have fallen the remainder of an injured leaf is quite green and appears to be perfectly healthy; nevertheless, such injured leaves invariably fall quite early in the season. As a rule, when the disease once attacks a tree, almost every leaf becomes infected, owing to the rapid production of spores, and it is not unusual for a tree to be completely defoliated early in the season. In such cases the formation of wood is checked, and there is a lack of reserve food which materially affects the succeeding crop of fruit. When nursery stock is attacked to the extent of causing defoliation for two or three seasons in succession, the trees never completely recover.

Remedial Measures.

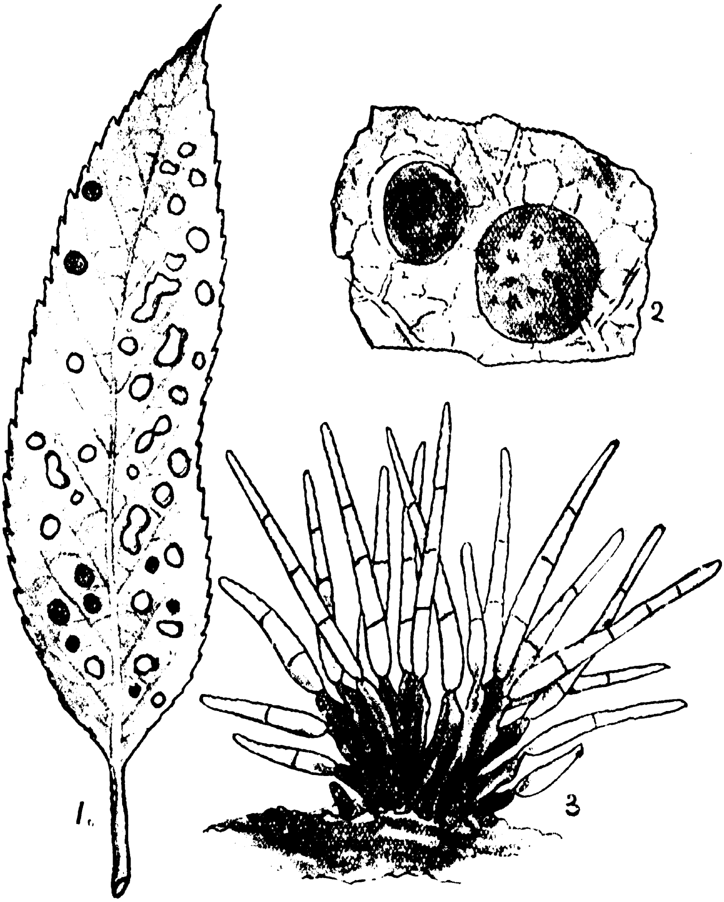
Peach foliage suffers most from the "shot-hole" disease in this country. In this case the disease is difficult to check, as, on account of the very tender nature of the leaves, Bordeaux mixture cannot be applied.

Dr. W. M. Scott, of the U.S. Department of Agriculture, has found that a fungicide, known as "self-boiled lime-sulphur mixture," can be used on peach foliage without injury. The proportions for a mixture ready for use are: 8 lb. lime, 8 lb. sulphur, 50 gallons of water. The following is the method of preparation:—

The mixture can best be prepared in rather large quantities—say 20 pounds, or even 40 pounds, at a time—so as to get enough heat to produce a violent boiling for a few minutes. Place the lime in a barrel and pour on enough water (about 3 gallons to 20 pounds) to start it slaking and to keep the sulphur off the bottom of the barrel. Then add the sulphur, which should first be worked through a sieve to break up the lumps, and finally enough water to slake the lime into a paste. Considerable stirring is necessary to prevent caking on the bottom. After the violent boiling which accompanies the slaking of the lime is over, the mixture should be diluted ready for spraying, and at least enough cold water added to stop the cooking. Five to fifteen minutes are required for the process, according to whether the lime is quick-acting or sluggish. The intense heat seems to break up the particles of sulphur into about the physical condition of precipitated sulphur, and the violent boiling makes a good mechanical mixture of the lime and sulphur. Only a small percentage of the sulphur—enough to improve the adhesiveness of the mixture—goes into solution, but if the hot mass is allowed to stand as a thick paste the sulphur continues to unite with the lime, and at the end of thirty or forty minutes enough of the reddish liquid is produced to burn peach foliage, and even apple foliage in some cases. Hence the necessity for cooling the mixture as soon as the lime is well slaked. The finely divided sulphur in mechanical mixture with the lime is depended upon for the fungicidal action rather than the sulphides in solution, the latter being harmful to foliage except in very dilute form.

The mixture should be strained through a sieve of 20 meshes to the inch in order to remove the coarse particles of lime, but all the sulphur should be worked through the strainer.

The amount of water required to make the best mixture depends largely upon the lime. Some grades of lime respond quickly and take a large quantity of water, while others heat slowly and are easily "drowned" if too much water is added at once. Hot water may be used to good advantage in preparing the mixture with sluggish lime, but with quick-acting lime hot water is not necessary, and is likely to bring too much of the sulphur into solution. If desired, the mixture may be kept for a week or more



SHOT-HOLE FUNGUS (*Cercospora circumscissa*, Sacc.).
1.—Diseased peach leaf (*nat. size*).
2.—Diseased patches bearing the fungus (*mag.*).
3.—Fruit of fungus (*highly mag.*).

without deterioration, but should be thoroughly stirred before using.

In applying the self-boiled lime-sulphur mixture, the spraying outfit should be equipped with a good agitator. The mixture settles to the bottom of the tank, and unless kept thoroughly agitated cannot be evenly applied.

Spraying should be commenced early in the season, when the foliage is about half-grown, and repeated as necessity demands.

If the soil be dug over during the winter, material capable of infecting the foliage in the spring would be buried.

Whitehall Place, London, S.W.,
January, 1911.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

Leaflet No. 248.

BOARD OF AGRICULTURE AND FISHERIES.

The Sclerotinia (Botrytis) Disease of the Gooseberry or "Dieback."

This leaflet is now incorporated in Leaflet 234 on "Botrytis Diseases."

Leaflet No. 249.

BOARD OF AGRICULTURE AND FISHERIES.

"Couch" or "Twitch."

The terms "couch," "twitch," "scutch," "squitch," "wicks," and "quack grass" are often applied by farmers in a general sense to several perennial weed grasses which creep on or below the surface of the soil.

Three species of grass are commonly known by the name "couch":—

(1) True "Couch" or "Twitch" (*Agropyrum repens*, Beauv.; *Triticum repens*, L.).

(2) Black "Twitch" or common bent grass (*Agrostis vulgaris*, With.).

(3) Onion "Couch" (*Arrhenatherum avenaceum*, Beauv. var. *bulbosum*, Lindl.).

These are amongst the most troublesome of all weeds of arable land, and when they are once established a great deal of expense must be incurred before the land is again clean enough for the successful growth of crops.

(1) *True "Couch" or "Twitch."*

Common Couch Grass (*Triticum repens*, L.) is one of the most commonly distributed of European grasses, and grows on a great variety of soils. It is rarely present in pastures and meadows, but is found in almost all hedgerows and upon banks separating or bordering arable fields, and rapidly spreads from these situations over the cultivated land unless steps are taken to check it.

The plant has whitish fleshy rhizomes, or underground stems, of the thickness of coarse string or a stout knitting needle, at the nodes or joints of which buds are produced, and also adventitious roots (Fig. 1). From the buds arise the upright growing stems, which come above ground and bear the ordinary green leaves, and ultimately the ears or inflorescences of the grass. The leaves are generally somewhat hairy on the upper surface, and at the point where the sheath and blade meet there are two hook-like ears or auricles which practically clasp round the stem.

The ears or inflorescences are placed at the end of the stems (which are 1 to 4 ft. long), and are built on the same plan as those of wheat, the spikelets being arranged in two rows alternately on opposite sides of the main axis or stem. Each spikelet consists of three or five flowers, and is placed so that its flat or broadest face is next the axis, whereas in

the ears of perennial rye-grass, which those of couch resemble superficially, the spikelets are arranged with the narrow, rounded face towards the axis of the ear.

FIG. 1.—True "Couch" (*Triticum repens*, L.) showing portion of creeping root-stock, and two views of flowering spike. Natural size. Spikelet enlarged.

The pest is propagated in two ways, namely, by seeds and by the underground rhizomes. Ordinarily the plants have not much opportunity to flower among farm crops, but flowering specimens are commonly seen in July and August in the hedgerows. The seeds ripen a little later and are blown on to the land, where they germinate and produce a new crop of weeds. Sometimes the seeds are introduced in unclean samples of grass and seed-oats. Though more couch plants arise from seeds than is generally supposed, the chief mode of propagation is by means of the creeping underground stems. These spread through the soil and soon form a dense mat of couch, which it is difficult to remove. In addition to natural extension from one point of the field to another, the plant is inadvertently spread by the farmer during the cultivation of the land. The rhizomes get broken or cut up into short lengths by ploughs, hoes, and cultivators, and are moved about in the soil by these implements. Each small piece on which there is a single joint or node has its bud and set of adventitious roots. and is virtually a complete plant capable of extensive growth.

It will be readily understood that a single couch plant may become broken up into a large number of such growing pieces and soon cover a wide area of ground.

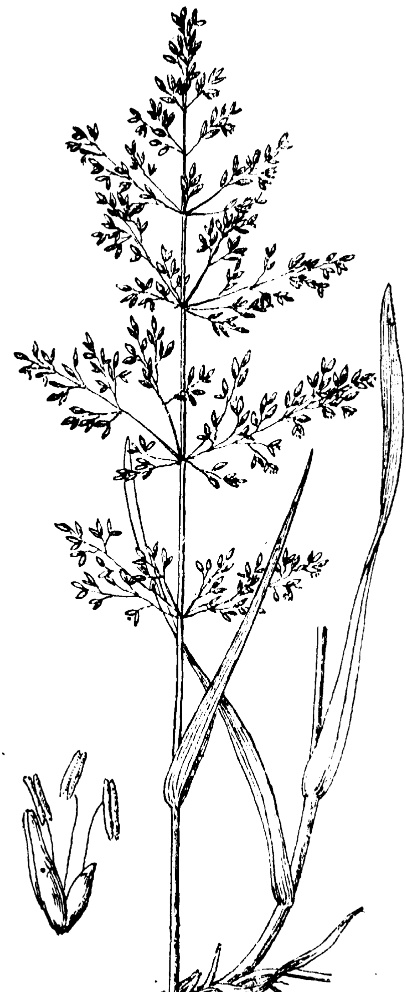


FIG. 2.—Black "Twitch" or Common Bent Grass (*Agrostis vulgaris*, L.). Natural size. Spikelet enlarged.

(2.) *Black "Twitch" or Common Bent.*

Black "Twitch" (*Agrostis vulgaris*, With.) has a creeping habit, but its stems lie on the surface of the soil, or just under it, and do not creep below like those of true couch, while they are much thinner. In some districts this is far the more prevalent kind of twitch. The leaves are short and flat, and dull green; in some forms smooth, in others rather rough. The inflorescence is a panicle with fine slender spreading branches and purplish-green one-flower spikelets of very small size (Fig. 2). There are no auricles at the base of the leaf-blade, but there is a membranous struc-

ture—the ligule—where the blade and sheath join. In true couch the ligule is absent or extremely short. These differences serve to distinguish black twitch from true couch when the plants are not in flower.

Black twitch, of which there are several slightly different varieties, is as troublesome as couch, and is propagated in the same way, namely, by seeds and by its creeping stems.

(3.) *Onion "Couch."*

This plant (*Arrhenatherum avenaceum*, Beauv. var. *bulbosum*, Lindl.) is a variety of tall oat-grass met with locally, more particularly on the lighter class of soils. It is known as bulbous oat-grass, knot oat-grass and pearl grass, owing to the peculiar character of its swollen root-stock. Where it has once got possession of the land it is most difficult to get rid of entirely. The characteristic features of this pest are the swollen internodes found at the base of the stems just below the surface of the soil.

FIG. 3.—Onion "Couch" (*Arrhenatherum avenaceum*, Beauv. var. *bulbosum*, Lindl.). One-half natural size.

Each "onion," "bulb," "pearl," or "knot" is solid, smooth, and round, about the size of a large pea, and is capable of

withstanding drought for a long time. Several are joined together, and resemble a short string of beads (Fig. 3). They are easily detached from each other by harrows and other implements, and as each little knob possesses a bud the pest readily spreads over the land. The inflorescence of the plant is a large panicle, the branches of which are somewhat closely pressed to the main stem both before and after flowering. The spikelets and "seeds" are as large as those of a small oat, and resemble them in form; the flowering glume has a bent twisted beard or awn attached to it.

The fibrous-rooted variety of tall oat grass is a valuable forage plant.

Preventive and remedial measures.

1.—As all these pests are spread by means of their seeds, which are easily blown about, every effort should be made to prevent flowering, and great care should be taken to procure grass-seeds and seed-corn free from the seeds of these weeds.

2.—Hedgerows must be kept clear of the weeds, for seeds are freely disseminated from plants growing in such positions. Moreover, if the hedgerows contain couch of any kind, it will grow out into the headlands, and the first cultivation spreads pieces of rhizomes or the small "bulbs" of onion couch farther into the field, and year by year the weeds extend.

3.—Where the couch has become established, repeated ploughing, grubbing, and harrowing must be practised in order to reduce it. The land should be ploughed at first with a shallow furrow, and as much as possible of the weed collected by grubbing and harrowing when the soil is in just the right state of dryness to leave the roots and creeping stems of the weeds easily. The passage of a roller over the land greatly assists the harrows to shake off the soil from the couch and allow the collection of the weed in unbroken lengths. Especial pains should be taken in the case of onion couch to avoid breaking up the clumps of "knots." Hand-picking should therefore be resorted to. After gathering together, the weed should be burnt in heaps and the ashes spread over the land.

Care should be taken not to grub or harrow in wet weather, especially on the heavier kinds of land, or much mischief will be done. When wet, the clods are cut or roughly broken by implements into irregular lumps rather than pulverised, and the creeping stems are severed into short lengths too small to be effectively gathered by any implement. This also happens when the land is too dry.

The best time to carry out the operation is when the soil readily falls into a fine, crumbly powder, and leaves the roots and rhizomes of weeds clean.

4.—A short rotation, including extra root or hoed crops, will be of great value in combating all species of "couch." *After cleaning in the manner indicated under section 3, the* land should be sown with mangolds or other root crops, and the horse-hoe with grubbing tines should be kept at work between the rows as long as possible.

5.—Rape, vetches, or other similar crops which will grow luxuriantly and smother weeds may be grown with advantage.

6.—In some cases isolated patches of couch may be forked or dug out and carried off the land.

7.—Should onion couch have become so plentiful that a field is over-run with it, paring and burning may be necessary to eradicate it.

8.—Common couch (*T. repens*) may be eradicated by laying land down to grass for three or four years.

Whitehall Place, London, S.W.,
May, 1911.
Revised, August, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

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Leaflet No. 250.

BOARD OF AGRICULTURE AND FISHERIES.

Fruit Bottling for Small Holders.

This method of preserving fruit is quite distinct from jam-making, and is much simpler.

It enables the grower to make the fullest use of all fruit which reaches maturity, by preserving it for home consumption or for sale during the months when fresh fruit is unobtainable.

Few operations could be more simple or easy to perform than fruit bottling, which requires only the care and attention of an ordinarily intelligent person. Where only small lots of fruit are to be bottled, a large saucepan, boiling pan, fish-kettle, or similar vessel for heating water is the only utensil required. When, however, the grower finds that he can profitably dispose of a fairly considerable quantity of bottled fruit, a larger type of boiling pan holding one or two dozen bottles, or a small sterilising outfit, may usefully be employed. A few shillings will purchase a suitable flat-bottomed iron pot to hold several bottles, while a small steriliser holding six bottles, for use with an oil or gas stove or a kitchen fire, may be obtained for about 15*s*., or one containing eighteen bottles for about £1 5*s*.

Bottles.

Wide-mouthed bottles of various patterns specially made for the purpose with air-tight covers or screw tops may be obtained through almost any ironmonger at 3*s*. per dozen and upwards, the price varying with the size and quality. Bottles may be obtained at lower rates when purchased by the gross through wholesale dealers. When counting the cost of bottling for home use it is well to remember that the same bottles may be used repeatedly until broken ; the chief renewals required are rubber rings, which are used with bottles for rendering them air-tight.

It is absolutely essential that the bottles should be air-tight. An imperfectly-fitting rubber ring or cover may be sufficient to cause failure after perfect sterilisation. As perfect fitting cannot always be guaranteed, there will be some bottles the contents of which will go bad. If signs

of spoiling appear in any bottle the contents should be used at once, or they may be emptied into a new bottle and re-sterilised. Bottles are illustrated in Figure 1.

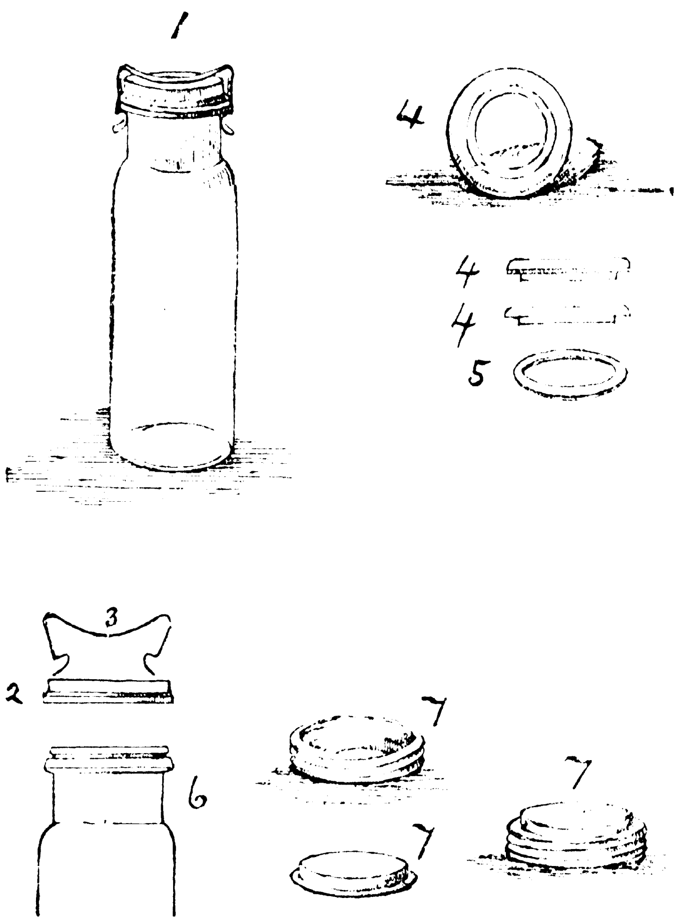

FIG. 1.—1. Glass bottle with metal cap and spring fixed; 2. metal cap; 3. spring; 4. glass cover or cap; 5. rubber ring; 6. top of bottle without cap; 7. screw and cap for screw-top bottles.

Fruit Suitable for Preserving.

Any fruit may be preserved by the bottling process, either whole, or sliced. Apples, pears, apricots and peaches may

all be used, though the bulk of bottled fruits consists of plums, gooseberries, cherries, raspberries, loganberries and currants. Plums and gooseberries are probably most largely used. When once properly sterilised and the bottles quite air-tight, the fruit will keep almost indefinitely.

The Use of Syrup.

The use of syrup is not essential, pure water being equally suitable and rather more transparent, and thus improving the appearance of the fruit after sterilisation. Moreover, a thin syrup spoils the natural flavour of the fruit without making it sufficiently sweet to render further sweetening unnecessary when used. Sugar, therefore, should either not be used, or be used at the rate of from ½ to 1 lb. (according to the acidity of the fruit) of pure cane sugar to one quart of water. Pure cane sugar leaves the syrup tolerably clear.

Selecting and Preparing the Fruit.

The degree of ripeness of the fruit has a considerable effect on the appearance of the fruit after the bottling process is completed. Fruit should be slightly under-ripe for bottling, as the skin does not then break so readily during the process of preservation; with ripe fruit, breaking of the skin can hardly fail to occur, and the appearance is apt to be spoiled. In this respect under-ripe fruit will bear a higher temperature without injury than ripe fruit. All fruit used should be sound and without speck or injury of any kind. It is best gathered dry; but if it be damp or wet it should be heated a little longer. All fruit should be carefully graded, only that of equal size being placed in the same bottle. Good results are not attained by mixing large and small fruits, and such mixtures have not a satisfactory appearance.

Preparation before bottling varies somewhat according to the fruit concerned—for instance, gooseberries should be topped and tailed; currants lightly shredded from their stalks; rhubarb skinned and cut into pieces of a uniform size; cherries must be stalked, and, if possible, stoned; the hull should be removed from raspberries; plums, greengages, and damsons must have their stalks removed; large juicy plums may be cut into halves before being placed in the bottle; peaches and nectarines should be skinned, stoned, and halved; apples and pears must be peeled and "quartered." A silver or plated knife only should be used for preparing fruit.

Great care should be taken in placing the fruit in the bottles, for, if these are imperfectly filled, some fruits (*e.g.* strawberries) after sterilisation will rise, and leave a large

space at the bottom without fruit. Many have experienced this in their first attempts at fruit bottling. A stout stick or piece of wood, about twelve inches in length—blunt at one end and rather pointed at the other—is very useful in arranging and gently pressing fruit into position in regular layers. The fruit should be selected of nearly equal size and then arranged in the bottles systematically, pressing it into place by means of the stick when necessary. The bottles should be filled to the top of the neck, still using a little force in packing if requisite. Soft fruits like gooseberries and currants require shaking together in order to ensure close packing; rhubarb should be placed as far as possible in upright rows; plums should be arranged in rows, as by this means more fruit can be placed in the bottles.

As the bottles are filled with fruit, water may be added to within half an inch of the rim, or syrup as described above may be used. In the case of bottles with screw caps, the latter may be placed on loosely and partly screwed down in order that they may be readily screwed down tightly directly the sterilising process is completed. In the case of bottles with caps (either glass or metal) and springs the rubber rings should be softened in hot water, the cap should be placed on, and the spring placed in position ready for fastening down directly sterilisation is completed.

Sterilising.

As stated above, in the case of small lots an ordinary saucepan, boiling pan or fish-kettle may be employed to hold the bottles. While the pan is over the fire the bottles should be raised somewhat above the bottom by placing in the vessel a false wire bottom or a board ¾-inch thick and standing the bottles on it, otherwise they may crack. The bottles should then be "shoulder-deep" in the water. The temperature should be raised quite slowly, perhaps at a rate of 2° F. per minute, otherwise bottles may crack and the skin of the fruit may break and the appearance of the produce be spoiled. The necessary temperature should be maintained for a time suitable for the fruit being sterilised. Generally speaking, under normal conditions, an exposure of from 15 to 20 minutes at 155°-165° F. should suffice, if the time taken to raise the steriliser to that temperature is about three-quarters of an hour. The bottles should then be securely fastened down; in the case of screw caps the tops should be screwed further if possible as the bottled fruit cools. Each lot of bottled fruit should be examined on the day following bottling, and if any doubt is entertained as to the condition of any of it the doubtful bottles should be re-

sterilised at once. This may sometimes be necessary owing to faulty caps.

Where large quantities of fruit are to be bottled, a steam boiler may usefully be employed in conjunction with a steriliser of the type illustrated in Figure 2. This steriliser is a galvanised iron vessel about 4 feet long, 2 feet wide, and 2 feet high, raised somewhat from the ground on four legs. The lid (L) consists of a galvanised iron plate fitting over a number of bolts on the rim (R) of the steriliser, and screwed

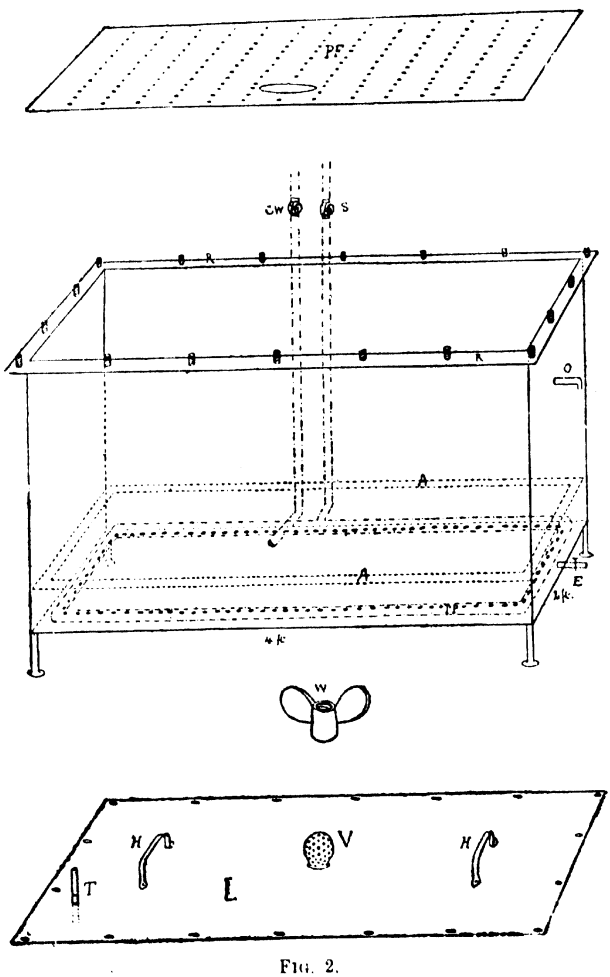

FIG. 2.

down by means of winged screws (W); two handles (H) serve to remove it or place it in position; a perforation (T) allows the insertion of a thermometer; and a perforated brass or copper vent (V) in the centre allows the escape of steam. The steam is admitted at the bottom by means of a pipe (S) from the boiler, and is equally distributed round the steriliser by a perforated pipe (PP) running round near the bottom. Cold water can also be admitted at the bottom by a tap and pipe (CW) connected with the usual water supply. An overflow (O) is provided at one end for the water, and a tap for the purpose of emptying the steriliser at the bottom (E). Bottles when filled are placed in rows in the steriliser on a perforated galvanised iron sheet or false bottom (PF) raised about 4 inches above the bottom of the steriliser on a ledge (A); they should not be fastened down, but caps should be as nearly as possible in position. The lid is screwed on and the thermometer inserted (the bulb standing in a jar of water inside the steriliser), and steam is then gradually admitted in increasing amount to raise the temperature *slowly* to the desired point. After maintaining such temperature for the requisite time steam is partly shut off, the lid is removed, and the bottles quickly closed down by means of the gloved hands while the live steam is still playing round the bottles. Steam and cold water are now admitted *together*, the water being gradually increased and the steam decreased in order to reduce the temperature quite slowly and avoid breakage of bottles. Finally, when the cold water reaches the shoulder of the bottles, these may be removed to finish cooling while another batch is treated. Such a steriliser will hold from six to eight or nine dozen bottles according to their size, and may cost somewhere about £25.

Co-operation.

Small growers may find it difficult to spare the necessary capital for the purchase of a sterilising outfit, and in such an event co-operative methods may be employed. A small steriliser could be used by several small growers, or if the amount of fruit to be bottled warranted it a larger outfit could be purchased.

In such a way several small holders and others may, by working together, bottle the whole of their surplus fruit for winter use or for sale, as the case may be, instead of selling it at a loss, or, as too frequently happens, allowing it to rot owing to heavy crops and low prices.

NOTE.—Though the word "sterilise" is employed in this leaflet it is not to be understood that the process of fruit bottling involves *complete sterilisation*, for some organisms may not be destroyed by heating to the temperature suggested. Owing, however, to the absence of oxygen, the relatively high percentage of organic acids present, and the small amount of soluble nitrogenous matter in the fruit juices, such organisms are rendered incapable of further development, except in occasional instances, which do not necessarily arise from any defect in the process. For peas, beans and other vegetables sterilisation should be complete; to effect this higher temperatures are necessary, for not only do these vegetables contain abundant nitrogenous matter, but they are deficient in organic acids.

Whitehall Place, London, S.W.,
May, 1911.
Revised, August, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

COMMON WEEDS.—I.

THE CORN MARIGOLD; DOCKS AND SORRELS; GOOSEFOOT; STINGING NETTLES; YELLOW RATTLE; POPPIES; AND CORN COCKLE.

The Corn Marigold (*Chrysanthemum segetum*, Linn.).

The Corn Marigold is a beautiful but destructive weed, attempts to eradicate which too often meet with failure. In one case an attempt was made to eradicate it by taking four successive green crops, but the weed was stated to be as flourishing as ever, and it practically destroyed three acres of barley, two of which were so bad that harvesting of the crop was not attempted. It is especially troublesome on loamy and sandy soils.

The corn marigold (Fig. 1) is an erect, composite plant attaining about 1½ ft. in height, and bearing beautiful golden-yellow flower heads some 1½–2 in. in diameter, flowering taking place from June to September, or even as late as October. The "seeds" of the corn marigold are very light and very easily blown from one field to another, while they are also said to lie dormant in the soil like the seeds of charlock. For this reason alone it is a most difficult weed to extirpate. Both seeds and flower heads are stated to be poisonous, and chaff containing many should therefore not be given to stock, but should be destroyed. Thäer says the seeds pass through the digestive system of horses, &c. without losing their vitality,* and where chaff contains only a few seeds it would be advisable to steam it well before use. Fream remarks on this plant† : "It is possessed of great vitality, and, when pulled up and thrown aside, does not perish and decompose, but continues growing and ripens its seeds." Seeds are produced in very large numbers, 13,500 having been found on a single plant.

The preventive and remedial measures suggested are as follows:—

(1) Sowing seeds absolutely free from the seeds of the corn marigold, especial care being taken to this end if the seed grain is grown in a neighbourhood where the weed is prevalent. Samples of red clover, sainfoin and grass seeds may contain the seeds of corn marigold, and their freedom from the pest should be ensured.

(2) Destruction of all seeds in chaff and threshing refuse by steaming.

(3) Hand-pulling of any large plants, and the thorough hoeing of two successive root crops in order to prevent any of the plants seeding. All removed plants should be *burnt.*

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* Complete Grazier, p. 858. † *Ibid.*

FIG. 1.—Corn Marigold (*Chrysanthemum segetum*, L.), about nat. size.

(4) Seeds which have fallen should be allowed to germinate, and the young plants destroyed by surface cultivation and hoeing. As the plant is an annual, the utmost care should be taken *every year* to prevent seeding. By persistent efforts, even the seeds which may be lying dormant for a time will be destroyed, though it may take several years to ensure success. As the seeds may easily be carried from farm to farm, the co-operation of neighbouring farmers should be sought in destroying the weeds.

(5) The corn marigold appears to favour soils deficient in lime, so much so that its presence is regarded as indicating the absence of lime. A good dressing of lime, therefore, may result in the disappearance of much of the weed.

Docks and Sorrels (*Rumex* sp.).

The botanical order *Polygonaceæ* includes a number of plants which are extremely troublesome both to the farmer and gardener, several species of the genus *Rumex*, or docks, being particularly harmful. These species of *Rumex* are indiscriminately known as Docks, two species, however, being almost invariably recognised as Sorrel or Sorrel Docks. Weeds of this genus occur on both arable and grass land, and all those considered here are perennial in habit.

The Common or Broad-leaved Dock (*Rumex obtusifolius*, L.) is a practically ubiquitous weed occurring in arable and meadow land, waste ground, &c. It is an erect plant, with a stout stem from one to three feet in height, and a large, strong, tapering rootstock descending deeply into the soil. The leaves from the base may be a foot long, and are oblong-lanceolate, with a somewhat waved margin and a slender stalk. The narrow panicle is leafy towards the base, and the small flowers, which appear in August and September, are on slender pedicels, and give rise to brownish triangular fruits resembling buckwheat. When in flower the panicle has a reddish-brown tinge.

The Curled Dock (*Rumex crispus*, L.) occurs in similar situations to *R. obtusifolius*, and may also be described as ubiquitous. The stout stem is branched (Fig. 2), and from one to three feet in height, and the rootstock is similar to that of the species mentioned above. The lanceolate leaves are from six inches to one foot in length, and much waved and crisped along the margins. The panicles are erect and branched, and consist of crowded whorls of small reddish or greenish flowers; the fruits are triangular and brown. Flowering takes place from June to October.

Other docks are more or less similar to *R. obtusifolius* and *R. crispus*—for example, *R. pratensis*, L., and, in damp grass land, *R. aquaticus*, L.—and all are harmful when they

occur in either arable or grass land. The two species described are common to almost all soils, and unfortunately possess the power of producing adventitious buds on their roots. Should a dock be cut off well below the crown, the portion of the root left in the soil will at once produce adventitious buds, and form a new plant, while the part cut off will not necessarily die, but, if left on the ground, may take root and produce flowers and seed. The seeds are a common impurity in grass and clover seeds, and it is believed that comparatively few samples of clover harvested in this country are, when harvested, entirely free from dock seed.

In grass land these species of dock must be attacked by regular spudding, or by removal with the docking iron when the ground is soft. The operation should take place well before the flowering period is reached, and all parts or plants removed should be burnt. It is the height of folly to throw docks into the hedgegrow or ditch, for they are practically certain to live and produce seed in their new quarters. A pinch of sulphate of ammonia placed on the cut surface of the spudded docks will almost certainly destroy the root. The fleshy roots of docks are so deep-seated that it is nearly impossible to remove them completely, the result being that the portion left grows again.

Where arable land is infested with docks the best course is to remove them bodily during the ordinary tillage operations, deep ploughing being necessary to this end. "Docking," or pulling up the docks by hand, should be persevered with where docks abound in growing crops. If a field is seriously infested with docks, the shorter the rotation the better will be the chance of getting rid of the weed. Seedlings should be eradicated by hoeing, and it has been remarked* that "were the hoe used in the root crops later in the year—in the autumn—seedling docks and seedling couch, which become established after that time, would have little chance of causing trouble." As in the case of other weeds, the greatest care should be taken to obtain only pure agricultural seeds, free from the seeds of docks.

Sheep's Sorrel (*Rumex Acetosella*, L.) is a perennial dock of small size—six to twenty inches in height—with a smooth, slender, branched stem, and a much-branched, extensively-creeping rootstock (Fig. 3). The lower leaves are hastate, or somewhat arrow-head shaped, and borne on long stalks, while the upper leaves are sessile and narrowly-lanceolate or linear. The panicles of small flowers are several inches long, branched and leafless, and male and female flowers are borne on separate plants. Flowering takes place from May

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* The Complete Grazier.

FIG. 2.—CURLED DOCK (*Rumex crispus*, L.).

FIG. 3.—SHEEP'S SORREL (*Rumex Acetosella*).

to August. Owing to the presence of acid oxalates, this plant is acid to the taste. Towards late summer and autumn it becomes reddish in colour. The small, triangular, yellow-brown fruits are a common impurity in clover and grass seeds.

Sheep's Sorrel is typically a weed of dry pastures, and is held to be an indication of poor, sour, sandy soils, and of the absence of lime; it is also very common in hay land, and also often occurs in arable land. Like other useless plants, Sheep's Sorrel replaces good herbage, and the best way to get rid of it is to improve the condition of the fields in which it occurs. This may be brought about by systematic manuring, and by *the application of lime* at the rate of 30 cwt. per acre if the land be light, or up to 3 tons per acre if the soil be heavy and wet. On heavy land basic slag will be of much value. In arable land, the application of lime, in conjunction with tillage operations, the hoeing of root crops, and the removal of the creeping roots, will have the effect of reducing it.

Common Sorrel (*Rumex Acetosa*, L.), the leaves of which are so commonly eaten by children on account of their pleasantly acid taste, and varieties of which are cultivated as a salad, somewhat resembles Sheep's Sorrel. It is, however, larger (one to two feet in height), and has a slender, simple stem, while the leaves are much larger and longer stalked than in the case of the other species. The branched panicle is leafless, and opens its flowers between May and August, the male and female flowers being on separate plants. The root-stock is a slender and tufted tap-root. Common Sorrel, Sour Dock or Sourock, is a perennial which occurs in most meadows, sometimes in great quantity. If not too plentiful, it may be spudded or regularly cut down, but removal by hand is impracticable as the tap-root is deep-seated. Dressings of mixed artificial manures *with lime* tend to weaken the Sorrel, while they at the same time encourage better herbage, and so choke out the weed. Regular cutting should be combined with manurial treatment.

Goosefoot (*Chenopodium album*, L.).

Few annual weeds are more troublesome to the farmer or gardener than Goosefoot, which is also known as Fat-hen, Meld-weed or Lamb's Quarters. It is closely related to the mangold and spinach and indeed frequently acts as a host to the Mangold Fly. It may attain to three or more feet in height, and occurs throughout the British Islands. It grows erect (Fig. 4), is much branched, with somewhat pointed and toothed narrow leaves up to three inches in length, the leaf stalks being long and slender or nearly sessile towards the ends of branches. The flowers, which appear from July to September, are borne in clusters on spikes placed in the

axils of the leaves and terminating each branch. They are small, greenish, and without petals. The seeds are black

FIG. 4.—Goosefoot (*Chenopodium album*, L.). Nat. size.

and glossy, and Percival has likened them in shape to a flattened bun. The colour of the whole plant is rather light green, and it has the appearance of being powdered with

white or pinkish particles. The seedling is of a silvery-green hue.

Goosefoot grows freely in waste land, but is a gross feeder and grows rapidly, attaining its greatest size and vigour on good cultivated loams or clays, where it frequently occurs in great quantity and gives much trouble, crowding and choking the sown crops. It occurs frequently on sandy loams, but appears to be uncommon on calcareous soils. It is especially plentiful among potatoes and other root crops, but not common among "seeds." Seeds are produced in abundance (possibly over 3,000 on one plant) and may lie dormant in the soil, coming up at unexpected times. The seeds are often plentiful in commercial samples of seeds of all kinds.

Where Goosefoot occurs among cereal crops it may be largely destroyed by surface cultivation with light harrows when the cereal is two or three inches high, the latter being deep-rooted compared with the weed, which in the young seedling stage is easily loosened from the soil. Should the plants occur in small numbers, or the growing crop be too far advanced to admit of the use of the harrows, or be otherwise unsuitable, hand-pulling should be resorted to, if possible in hot, dry weather. Among root-crops, Goosefoot should be attacked by vigorous and frequent hoeing when the plants are small, and on a hot day they will quickly wither. Large or late plants should be removed by hand, an endeavour being made in all cases to prevent seeding.

Stinging Nettles (*Urtica* sp.).

Two of our native species of "stinging" nettles are commonly troublesome in field and garden. One of these, *Urtica dioica*, L., is a tall perennial with creeping rootstock, and occurs in arable and grass land alike. The other, *U. urens*, L., is a much shorter plant, is an annual, and occurs chiefly in arable land.

The Great Stinging Nettle (*U. dioica*, L.) is a pubescent perennial 2–4 ft. or more in height, and covered with stinging hairs which may cause severe pain on piercing the skin of man. The leaves are ovate-cordate or lanceolate, pointed, serrated or toothed, 2–4 in. long, stalked, and placed opposite one another on the stem in pairs. The small green flowers occur in panicles 1–3 in. in length which spring in pairs from the axils of the leaves, the male panicles being loose- and the female dense-flowered. Flowering takes place during the summer months—June to September. The stems may be single or branched. The rootstock is extensively creeping, and thus, together with reproduction by seeds, this weed is able rapidly to overrun land on which it has once become well established. This nettle appears to grow well

on most kinds of soil, but is most prolific on land in good condition, whether arable or grass. Along the borders of meadows and pastures, particularly shady spots, it is often very troublesome, insidiously reaching farther and farther from the boundary into the field if nothing be done to arrest its progress.

In arable land this nettle is best combated by digging out and burning the rootstocks, following this up by thorough and continued cultivation and hoeing to destroy any further growth or any seedlings that may appear.

In grass land small patches may be dug out by hand and burnt, but this plan involves re-seeding.

In the case of either large or small areas this nettle may be dealt with by regular cutting from the time the shoots appear in the spring, cutting taking place each time the fresh shoots attain 6 in. to 1 ft. in height. This plan, thoroughly and regularly carried out, exhausts the reserves of food material stored up in the rootstocks, and eventually kills the weed. The eradication will be materially hastened by a dressing of salt (say at the rate of 5½ lb. per rod, or on larger areas 6 or 7 cwt. per acre) when the nettles are first cut in spring.

Experiments conducted in Germany* in 1909 with a view of destroying nettles on large areas, showed that the young shoots were destroyed in spring by spraying with a 15 per cent. solution of kainit, applied with an ordinary charlock sprayer. The shoots became black and died off, and the grasses won the mastery, so that at the time of hay harvest the area seemed quite free from the pest. Careful examination showed that the fresh delicate shoots from the rootstock appeared sickly and but little grown, while the rootstocks themselves were black and had begun to die. (As about 35 per cent. of kainit consists of common salt, it is probable that the effect of spraying with the solution of kainit is largely due to the salt contained therein.)

The Small Stinging Nettle (*U. urens*, L.) is much smaller than the last species, attaining only 1–2 ft., or rather over, in height, while it is an annual. It is also smooth except for the stinging hairs. The stem is branched; the leaves are stalked, 1–2 in. in length, ovate-oblong, pointed, coarsely toothed, and placed opposite in pairs on the stem. The panicles or spikes of small green flowers are bisexual, ⅓ to 1 in. long, and spring in pairs from the axils of the leaves. Wherever it occurs in arable land this nettle may be successfully combated by thorough and regular hoeing to prevent seeding for a year or two.

* *Prak. Blätter für Pflanzenbau u. Pflanzenschutz*, Aug. 1910, p. 97.

Yellow Rattle (*Rhinanthus Crista-galli*, L.).

This weed is frequently very troublesome to farmers. It is commonly known as Yellow Rattle, Rattle Grass, Rattles, Cock's-comb, or Horse-penny. It occurs as a weed in grass land, especially in damp or wet meadows and pastures, where it is partially parasitic on the roots of grasses, &c.

FIG. 5.—Yellow Rattle (*Rhinanthus Crista-galli*, L.). Nat. size.

Yellow Rattle (Fig. 5) is an erect-growing annual, and bears narrow serrated leaves, which are placed opposite one another on the smooth, quadrangular stem and its branches.

It may attain to 18 inches in height, and bears numerous flowers arranged in spikes, on which the flowers are turned in all directions. The corolla of the flowers is yellow, the upper lip being the longer and the lobes blue ; the lower lip has three lobes, and with the toothed appendages on the sides of the upper lip gives the flower a peculiar and characteristic appearance. The red-tipped calyx, after the fall of the corolla, resembles a Cock's-comb. The shape of the flower also gave rise to the name *Rhinanthus*, taken from the Greek words *rhis*, *rhinos*, the nose, and *anthos*, a flower, literally therefore the "nose-flower." Flowering takes place about May to June or July. The seeds are winged and are borne in roundish compressed, two-valved capsules, in which they rattle when shaken, thus originating some of the common names of the weed.

Distribution.—This weed is found throughout the British Islands as far north as Shetland, and in the Scottish Highlands occurs as much as 2,500 feet above sea level. Several cases have come to the notice of the Board in which Yellow Rattle has been the cause of much trouble and annoyance.

Injurious Effect.—Yellow Rattle is semi-parasitic on the roots of grasses and various herbs, and experiment has shown that it cannot be cultivated entirely by itself, though it may occasionally appear in arable crops after grass land has been broken up. Where it occurs extensively much harm will be done to the meadow or pasture, space being taken up and good plants crowded out, food materials being absorbed from the host-plants by the haustoria of the Yellow Rattle, while the plant is not liked by stock and reduces the value of the hay in which it may occur. It has been stated that the seeds of Yellow Rattle when ground up with wheat discolour and impart an unpleasant taste to bread made from the flour, while it is believed by some people to impart a bad taste to the butter made from the milk of cows grazing in fields where it occurs.

Soil and Situation.—The weed is generally regarded as a weed of poor meadow land, well drained, closely grazed and well cared for, rich pastures and meadows seldom being infested.

Remedial Measures.—Yellow Rattle is a very undesirable invader of grass land, and immediate measures should be adopted to eradicate it. One of the first methods which suggests itself is to mow the weed early before the seeds are ripened, and this is probably the best method of getting rid of it. Where land is intended for hay, mowing must take place early. It has been clearly shown that early mowing for two years in succession, so preventing seeding, has been followed by entirely satisfactory results.

Stock do not appear to like the plant, but close grazing with sheep seems to be useful. Thäer recommends

depasturing with sheep early in the spring, so that the year's growth of the weed is destroyed.

It may be said that on heavy land a dressing of 7 cwt. of basic slag applied before the end of November will encourage a luxuriant growth of clover, and if such pasture is closely grazed by stock the Yellow Rattle, as well as other weeds, will be prevented attaining normal growth and will soon disappear. Such an application of basic slag is only calculated to have the best effect if the field is grazed, not mown for hay, and the manuring and grazing must therefore be combined.

Top-dressings of salt at the rate of 5 to 7 cwt. per acre have, in some cases, proved very effective, even exterminating the weed. Such a dressing of salt may usefully be accompanied by grazing with sheep.

When the plant is found in damp, low-lying meadows and pastures, draining would be a useful measure.

Where the weed is spread over a pasture it has been recommended that the land should be broken up and one or two root crops taken in order to clean it thoroughly, when it may again be laid down to pasture. It is, however, doubtful if this is ever necessary, and owing to the expense involved the measures recommended above would be preferable.

Poppies (*Papaver* sp.).

Several very similar species of Poppy are among the most common weeds of cornfields in many parts of the country. Thus in parts of Sussex, the cornfields carry large crops of "Red Weed," as it is termed; in parts of Lincolnshire poppies are a great scourge; while so prolific are they in Norfolk that the district around Cromer has received the name of "Poppyland." In passing through a corn-growing district where poppies abound nothing is more striking and picturesque during the months from June to August than the scarlet-covered acres, but all who are acquainted with the harm done by an excess of weeds will understand the depreciation which a poppy-infested corn crop must suffer. The seeds, however, are so numerous and so easily spread that it is almost impossible to keep one farm in a poppy district clean if other farms are neglected.

Description.—There are four species of *Papaver* which may be said to be established in Great Britain: *P. Rhœas*, L., *P. dubium*, L., *P. Argemone*, L., and *P. hybridum*, L., while *P. somniferum*, L., the Opium Poppy, is an occasional escape from cultivation. Of the foregoing species, *P. Rhœas* and *P. dubium* are the most widespread, and are those most commonly occurring in cornfields, and will therefore alone be dealt with here.

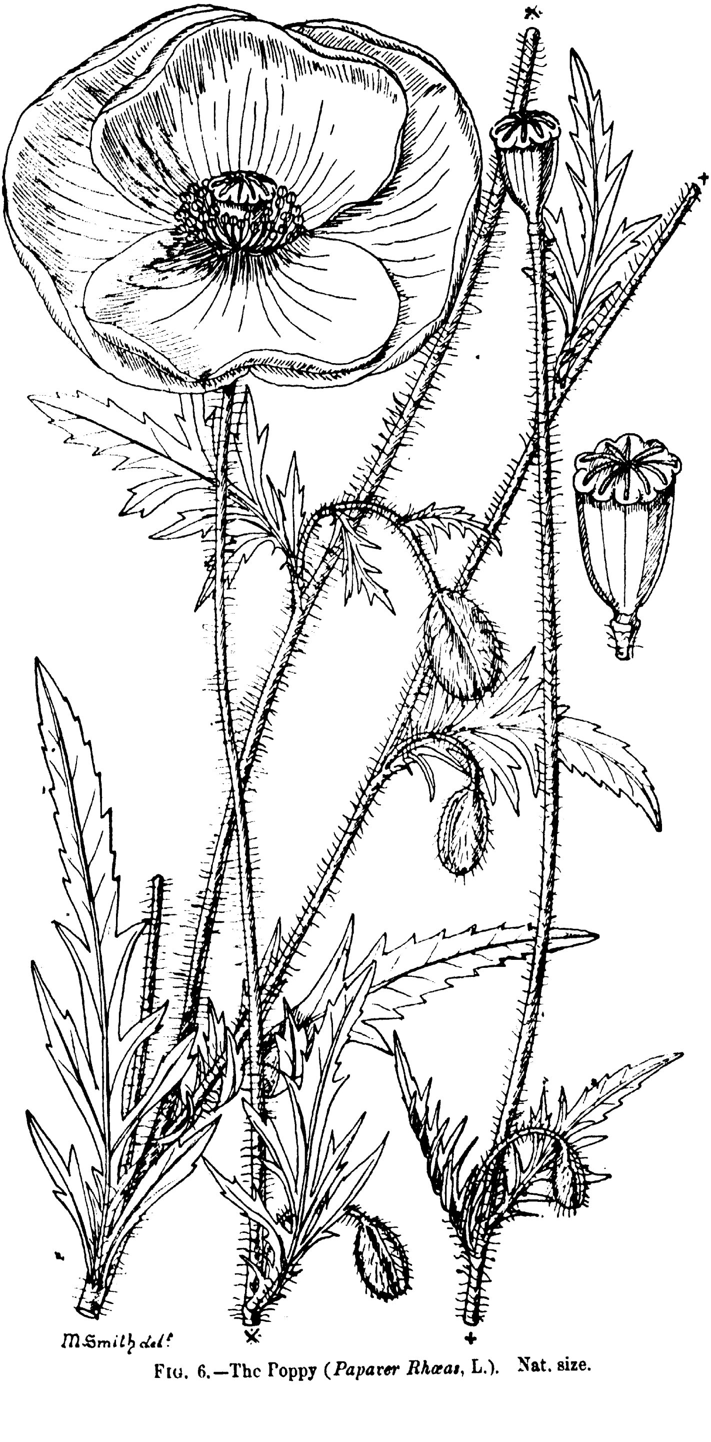

FIG. 6.—The Poppy (*Papaver Rhœas*, L.). Nat. size.

Both of these species are erect annual weeds, attaining one to two or more feet in height. They have deep tap roots and branched hairy stems and flower-stalks, the hairs in *P. Rhœas* (Fig. 6) spreading outward from the flower-stalk, but in *P. dubium* pressed close to it. The leaves are pinnatifid or "feathered," bearing segments arranged on each side of a common midrib. The stems exude a milky juice when bruised or cut. The flowers extend to three inches or more in diameter and are scarlet in colour. In *P. Rhœas* (Common Red Poppy), the seed capsule is not much longer than it is broad, while in *P. dubium* (Long Smooth-headed Poppy) it is more than twice as long as it is broad. In each case the capsule is smooth. The seeds are produced in large numbers (10,000 to 60,000 by one plant), and being very small they may, on escaping from the capsule, be blown considerable distances by the wind. They are, moreover, of an oily character, and may retain their vitality when buried in the soil for some years, germinating and producing mature plants when brought to the surface under favourable conditions.

Poppies pass under a variety of names, and A. B. Smith enumerates the following common names for *P. Rhœas* :—Corn poppy, Corn flower, Corn rose, Canker rose, Cock rose, Cop rose, Copper rose, Blind eyes, Headache, Red weed.

Distribution.—*P. Rhœas* occurs throughout the southern and midland counties of England, in Ireland and the Channel Islands, but, according to Hooker, is rare north of the Tay. *P. dubium*, on the other hand, is, according to the same authority, found in Britain north to the Shetland Islands, and also in Ireland and the Channel Islands.

Both these species are common weeds of cornfields and waste places. Although they are most commonly found on light, dry, sandy and gravelly soils, they nevertheless flourish even on heavy wheat land, though not to the same extent as on the lighter soils, such as barley land.

Life History.—While poppies have in some cases been present on farms for generations, they may be introduced to otherwise clean farms by means of unclean seed. The seed germinates most freely on a soil in good tilth in the spring, during damp, warm weather, while the established plants grow most rapidly and strongly during hot summer weather. Unless protective measures be adopted, flowers will quickly mature, seed capsules will be formed, and the thousands of seeds will speedily be distributed by the wind. Although subsequent deep ploughing may bury them, future cultivation will bring them to the surface, and the crops will again be infested, with a tendency to serious reduction in the yield.

*Narcotic Properties.**—Poppies contain active toxic or narcotic principles, and the drugs opium, morphine, and laudanum are prepared from them. Cornevin states that *P. Rhœas* is poisonous in all its parts, and sufficiently so to occasion accidents every year. Domestic animals may be poisoned when fed with clovers or sainfoin which are infested with the poppy, or even when they take the capsules with other waste matter from winnowing or grading cereals. In general, however, stock are safe where poppies abound, because the disagreeable taste and smell of the flowers and plants render them obnoxious to the stock.

Prevention and Remedy.—(1.) Great care should be taken to employ only clean seed corn for seed purposes.

(2.) Seeding should be prevented by hoeing out or hand-pulling whenever possible. Where seeding is known to have occurred, however, the procedure should be to encourage early germination in spring by endeavouring to keep the seeds at the surface and procuring a fine tilth. In damp weather the seeds will commence growth, and as soon as fine, dry weather occurs, surface cultivation with the hoe, light harrows, the poppy killer,† and the various types of American weeder, will tend to destroy the young plants. A repetition of this procedure will destroy a considerable proportion of the growing poppies, and after the corn crop is too high hand weeding may need to be resorted to.

(3.) Where the poppies occur in overwhelming numbers it may be advisable to forego a corn crop and take an extra root crop in the rotation, and by this means the poppies may be largely reduced.

(4.) In experiments conducted at the Woburn Experimental Farm in 1900 and 1901, poppy plants (*P. Rhœas*) were injured by spraying with a 2 per cent. solution of copper sulphate just before they came into flower, but afterwards recovered. When the solution was applied to the underside of the leaves as well as to the upper surface, "the leaves turned brown, became shrivelled, and to a great extent the plant was killed, for the seeding was almost entirely prevented, the flower heads withering up." Now in a tall corn crop with poppies nearly at the flowering stage, spraying could only be done by hand, and the wetting of the underside of the leaves could scarcely be accomplished. But since it is well known that in charlock spraying a 3 per cent. solution of copper sulphate does little if any damage to the corn crop, a 3 per cent. solution might be tested on poppies when they are no more than half or one-quarter

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* *See* also *Journal of the Board of Agriculture*, April, 1909, p. 28.

† See *Journal of the Board of Agriculture*, July, 1904, p. 196.

grown, at a time when the corn crop is not too tall to prevent the solution duly wetting the poppy plants.

Maier-Bode states that the common garden poppy is very sensitive to a 13 to 20 per cent. solution of sulphate of iron, and as a 15 per cent. solution has been found to do no permanent harm to the cereal crop when destroying charlock by this method, a solution of this strength might be tried.

To make a 2 per cent. solution of copper sulphate, 8 lb. should be dissolved in 40 gallons of water; for a 4 per cent. solution, 16 lb. in 40 gallons of water. To prepare a 15 per cent. solution of sulphate of iron, 60 lb. must be dissolved in 40 gallons of water. In each case 40 gallons of solution will suffice for an acre of the cereal crop. Powdered sulphates of copper or iron should be used.

Corn Cockle.

(*Agrostemma Githago*, L.=*Lychnis Githago*, Scop. et Lam.=*Githago segetum*, Desf.)

Description.—A weed of cornfields which is a considerable annoyance to the farmer is that known as Corn Cockle, Corn Campion, or Purple Cockle, and also as Bastard Nigella, and Wild Savager. It occurs on sandy, loamy, or clay soils, and some authorities have held that its presence indicates a poor soil or neglect in cultivation.

Corn Cockle (Fig. 7) is a handsome, erect plant, 2 to 4 feet in height, and covered with smooth white hairs. The straight leaves are up to 5 inches long, narrowly lanceolate, and placed opposite one another in pairs on the stem. The large pale purple or violet-red flowers, 1½ to 2 inches in diameter, are borne singly on long stalks which spring from the axils of the leaves; they open from June to August. The large petals are five in number, and the corresponding sepals are green, narrow, and very long, extending much beyond the petals.

The fruit (1) may be described as a one-celled capsule opening at the top by means of five teeth. This seed capsule contains from 20 to 40 seeds, and Perseke states that from 1,000 to 2,000 seeds have been counted on a single plant, while Nobbe quotes as many as 2,590. The seeds (2) and (3) are rough, black or dark brown, and irregularly spherical, and owing to their comparatively large size (3 mm. or one-tenth of an inch, or even more, in length) they are not easily sifted from wheat.

The seeds are odourless, but bitter to the taste when chewed, and their weight averages 8 milligrams (Cornevin)

CORN COCKLE (*Agrostemma Githago*, L.).

FIG. 7.—1. Fruit, nat. size. 2. Seeds, nat. size. 3. Seed, enlarged.

When ground up with wheat they discolour the flour, and are stated to give a greyish tint, disagreeable odour, and bitter taste to bread when baked. Portions of the black, rough seed coats remain sufficiently large and characteristic to ensure their recognition under the microscope. Though experimental results are somewhat contradictory in character, it is clear that poisoning by corn cockle has occurred under a variety of conditions, and the evidence is sufficiently conclusive to show that the consumption of the seeds should be carefully avoided, and waste material from threshing, winnowing, or otherwise cleaning grain should always be destroyed when it contains more than a small amount of cockle seed. Indeed, it appears to be generally the best plan to burn all foul screenings. The toxic principle is not removed by the heat of an ordinary oven in baking, or by boiling.*

Corn cockle is a hardy annual, the seed appearing to germinate either in spring or autumn, in the latter case the young plants becoming well established before spring. Thäer says that while botanically an annual it rather appears agriculturally as a biennial, and that the seeds germinate and the first leaves grow at so low a temperature that it appears more as a weed of winter corn than spring corn.

Prevention and Remedy.—An endeavour should be made to prevent seeding, and this may perhaps be best done, in well-grown corn crops, by hand-pulling the growing plants. Where the weed is known to be very plentiful the seeds may be encouraged to germinate by spring and autumn cultivation, the seedlings being subsequently destroyed by harrowing.

Repeated harrowings of the grain crop may be the means of destroying large numbers of the seedlings.

It will also be a useful measure in a case of severe infestation to abandon autumn-sown cereals for a time in favour of late-sown spring cereals, in which case the winter and late spring tillage will tend to destroy the young seedlings which have appeared.

Short rotations will be a great help in getting rid of corn cockle, and thorough cleaning of root crops will kill a great deal of the weed.

It may be suggested that, as the seed of corn cockle ripens about harvest time, a box attachment behind the platform or pan of a reaping machine will catch many seeds which would otherwise be scattered on the stubble.

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* See also *Journal of the Board of Agriculture*, April, 1910, pp. 41-44.

Care should be taken that only pure seed grain be used, and cereal crops intended for seed should be thoroughly cleaned of corn cockle. The weed also grows freely among leguminous crops, particularly vetches, and here also the pest should be hand-pulled, while too great care cannot be taken to prevent the seeds being harvested and distributed with the seed. Owing to their size and roughness the seeds are separated with difficulty from wheat or tares by means of ordinary sieves.

Whitehall Place, London, S.W.,
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Leaflet No. 251.

BOARD OF AGRICULTURE AND FISHERIES.

Pruning Fruit Trees.

To prune fruit trees efficiently the operator must be well acquainted with the principles upon which the art of pruning is based, and expert in the practical application of those principles.

Irrational and *unskilful pruning* may have very disastrous results.

It is necessary to know *why to prune, how to prune, and when to prune.*

The objects of pruning.

The objects of pruning are :—

(1.) To form the tree : trees are grown to certain forms for definite reasons, and these forms are obtained by pruning.

(2.) To subject all parts of a tree or bush (limbs, shoots, leaves, buds, and blossoms) to their due share of air and sunlight, so that they may perform their functions with proper interchange, mutual assistance, and evenness in results ; a condition of health and productiveness is thus maintained throughout the entire plant.

(3.) To induce fruiting and improve the quality and quantity of fruit.

(4.) To facilitate cultural operations : tillage, spraying, fruit gathering, &c.

(5.) To remove dead, damaged, or diseased parts.

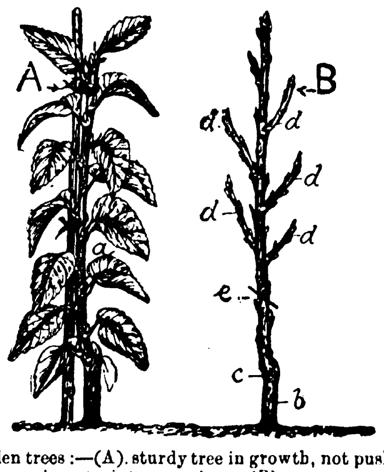


FIG. 1.—Maiden trees :—(A). sturdy tree in growth, not pushing laterals ; (*a*), point of shortening at winter pruning. (B), strong growing tree with laterals : (*b*). stock ; (*c*), junction of scion (apple) with stock (English Paradise) ; (*d*), laterals ; (*e*), point of shortening for bush form of tree.

The pruning of matured wood growth—branches or shoots a full season old, or older—should be performed when the tree is dormant, and is known as "*winter pruning.*"

The mere shortening or suppression of laterals and "incommoding growths" may be done while these are still in growth in summer and autumn, and the processes are known as "*disbudding*" and "*summer pruning.*"

The actual operation of pruning a fruit tree should only be undertaken by persons who have acquired some skill in the use of pruning implements. By practising with knife, shears, and saw upon wild plants, such skill may be acquired. All implements should be keen and in perfect order.

FIG. 2.—Second year's tree:—(C), tree B, Fig. 1: (*f*), laterals pinched to one leaf as made; (*g*), points of shortening at winter pruning; (*h*), stem from which all growths but the three shown have been removed at an early stage of the year's growth.

All cuts should be clean and decisive, with no compromising of the limbs, shoots, or buds remaining upon the tree or bush: saw cuts and large wounds should be trimmed to smoothness with the knife and sealed over with white lead and oil paint, or carpenters' knotting.

Pruning an Apple Tree into Bush Form, from a "Maiden."

First Year.—The maiden tree should be headed back at the fourth or fifth well-defined wood-bud on the scion portion of the stem, counting from the lowest of such buds. The lowest bud will usually be found at a point on the stem

from six to nine inches above the soil level, and this is a convenient height for the lowest of the main branches to be. The young tree will then be from 15 to 22 inches high, according to the position of the lowest bud and the distance of the buds apart, this distance varying with the variety.

This heading back should be performed at the time after planting when the trees show the first signs of growth.

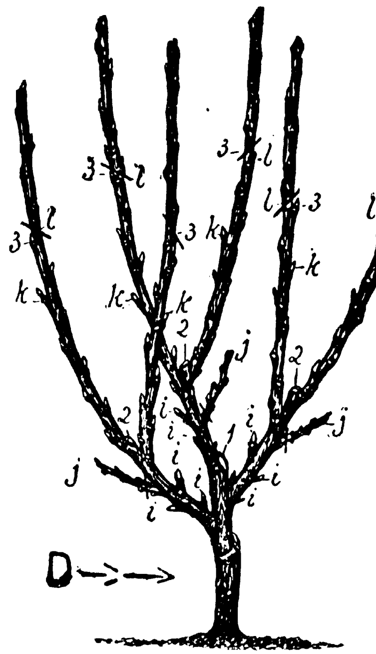


FIG. 3.—Third year's tree :—(D), tree C, Fig. 2 : (*i*), spurs (stubby shoots with rounded bud) not to be shortened ; (*j*), side shoots not required for forming branches, stopped during growth at the third leaf (not counting small basal leaves), and cut back at the winter pruning to a couple of buds as shown by the cross lines ; (*k*), spur-like buds (sometimes blossom buds), otherwise forming spurs the following season ; (*l*), points of shortening. The numerals indicate years of growth and pruning.

In the case of a "feathered maiden," the heading back should be the same as with the unsprouted tree, and any shoots that may be left on the stem after the heading back should also be cut back hard to the first bud from the stem pointing in the direction in which it is desired that the future branch from that bud shall grow.

In the late spring or early summer when the buds have attained well defined growths, all shoots other than three or four required to form a well balanced "head" on a short straight "leg," may be rubbed or cut out.

Care must be taken to suppress any growths from the "stock" portion of the stem, or any "sucker" growths coming from the roots; these latter should be *cut clean off at their junction with the root.*

If the leaf growth on the shoots left to form the "head" appears to be insufficient to afford proper nourishment to the tree, the removal of superfluous growth should be only partial, or, if need be, deferred until the permanent leaders have developed enough leaf to ensure adequate elaboration of food.

In the ensuing winter—as late as time will permit of the operation being performed before spring growth sets in—the "leaders" should again be cut back, moderately or severely according to their vigour and the maturity of their growth. The strong growths need only be cut back to a point where the wood and buds are thoroughly matured; feeble growths, however, should be cut hard back to a third or one quarter of their length, thus ensuring vigorous growth in the ensuing season in that portion of the tree, and establishing *balance* in the head. Great care must be exercised in cutting back to buds so placed that the *extension* of the branches in their proper directions is guaranteed, *i.e.*, to "outside," "inside," "top," or "lower" buds as each case demands.

The object is to form a "head," open in the centre, and having limbs so spaced that they grow without interfering with each other, and that there be free access of air and sunlight to all parts.

This completes the pruning of a "Bush tree" in its first year.

Second Year.—In the second year the side-growths (laterals) on the main branches should be cut back in summer (July) to five or six leaves, but the top growth (leader) should be left untouched. Any vigorous shoot growing in a position where it is of use in filling in a gap in the frame of the tree may be left and treated as a "leader." In September the tree may be inspected again, and the above process be repeated where necessary.

In the *winter* the lateral growths should be cut back (spurred back) to one or two buds at their bases, and the leaders reduced in the same way and on the same principles as in the first year, *i.e.*, cut lightly or severely in accordance with vigour, due attention being paid to the position and future action of the buds pruned to.

Third Year.—In the third year the pruning is similar in principle and practice to that of the second year, but it will then be found that fresh growths may be selected to become permanent branches without crowding, or upsetting the principle of "open centre, circulation of air and light and freedom for each individual branch."

At all "prunings" dead and diseased growths must be removed.

In subsequent years, if the pruning has been systematically practised on proper principles in the early life of the tree, it can be continued on those same principles, and it will be found that as the tree ages and approaches its limit of growth, producing fruit increasingly, the amount of "pruning" required will decrease.

In pruning due consideration must be paid to the condition and "habit" of each individual tree, and the "habit of growth" in different varieties, which is very varied, must be carefully studied and allowed for.

It should be borne in mind that "pruning" and "manuring" of fruit trees may easily work at cross-purposes in their effects. They may be made to act together to the benefit or the reverse of the tree as a fruit-producer in accordance with the judicious or injudicious use of fertilisers, especially those of a nitrogenous character.

Pear, Plum, and Cherry.—The same general principles which apply to the pruning of an apple tree hold good with the pear, plum, and cherry, but due allowance must be made for their different habits of growth and fruit bearing.

Standard and Pyramid Trees.

The formation of the "head" of a "standard" fruit tree is effected on much the same lines as in the case of the "bush," but the cutting back and the spurring is not so vigorous, the main object being to keep the head nicely open.

The same principles apply in developing the "pyramid" form of fruit tree. In the "pyramid," however, the central stem is allowed to prolong itself to the full height of the tree and the branches are made to radiate evenly from the central stem. Great care should be taken to have the branches of a pyramid tree well spaced and not too numerous.

Pruning older Trees.

Orchards are sometimes planted with trees two, three, and even four years old. As in the case of the "maiden" such trees must be cut back after planting, the severity of the pruning depending largely upon the manner in which they have been treated in the nursery with a view to their formation. The pruning must be conducted in such a way that the trees are trained to the desired form in their permanent places in the orchard. Whatever their ages, trees newly planted out should be cut back in their *first* year in the orchard.

Pruning Established Trees.

Apples.—Different varieties of apples vary in character, and a rule of pruning free from exceptions cannot be laid down. The great majority of varieties are sufficiently alike for the apple to be classed as a spur bearer, the young wood bearers, such as Lady Sudeley, Irish Peach, and Cornish Gilliflower, which produce fruit at the tip of small shoots, not being numerous. The routine pruning of the apple may differ slightly from that of a pronounced spur bearer, such as the pear, in that young wood, if well ripened, will frequently form fruit buds along the greater part of its length. Generally

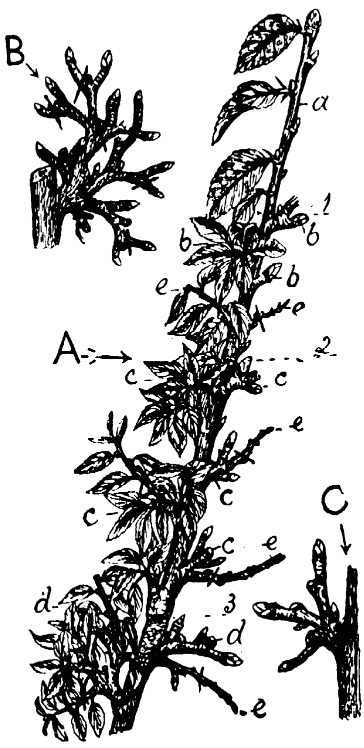


FIG. 4.—Pruning apple-spurs :—(A), portion of a branch : (*a*), extension growth terminated by a blossom bud (as common with Irish Peach, Lady Sudeley and Golden Noble) ; (*b*), one-year spurs with blossom buds ; (*c*), two-years spurs ; (*d*), three-years spurs ; (*e*), spur growths pinched to three leaves in summer and shortened in winter to the cross lines. (B), branched spur marked for thinning. (C), spur with long stragglers cut off, thus keeping the spurs close to the branch

speaking, breast-wood should be kept down, but where there is room a young shoot may be allowed to extend, and in its second year it will probably fruit (Fig. 4).

If the main branches of most apples are kept thin—fifteen inches apart at a yard from their base—they will, as

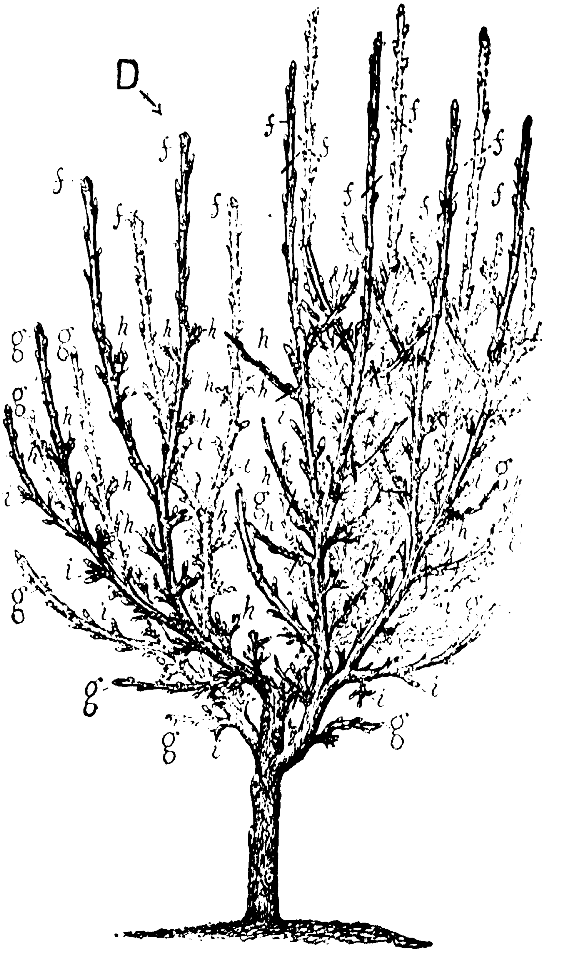


FIG. 5.—Pruning apples:—(D), young wood tree. Left hand side of tree after pruning, back branches shown in dotted outline for clearness. Right hand side of tree unpruned, but marked for shortening by cross lines; (*f*), extension growths shortened, or marked for it by cross lines, in order to induce buds to start on the whole length of the previous year's wood; (*g*), short extensions to be left intact; (*h*), shoots summer pinched and shortened to two "eyes" at the winter pruning; (*i*), spurs.

they mature, form spurs, which will break into leaf and blossom in spring. The wood shoots developing from them may be summer pruned and cut back close to their base at the winter pruning. Any side shoots other than those from spurs may be treated in the same way (Fig. 5).

FIG. 6.—Summer pruning apple shoots :—(E), portion of branch with characteristic growths : (*j*), extension growth pinched at the sixth good leaf, not counting small basal leaves (*k*) ; (*l*), side growth not extending more than five or six leaves and terminated by a bold bud (*m*), generally a blossom bud ; (*n*), spurs (a short stubby growth, the leaves disposed in corona, with a prominent bud in the centre) ; (*o*), growing side shoots pinched at the third good leaf. (F), portion of branch in bearing : (*p*), extension ; (*q*), laterals (not to be pinched unless extending beyond three leaves) ; (*r*), side growing shoots pinched ; (*s*), one-year spurs ; (*t*) two-year spurs.

Summer Pruning. — Summer pruning is of great advantage to the apple, as indeed it is to all spur-bearing fruits when trained or grown as bushes, as it prevents over-crowding. Vigorous varieties growing in rich soil make an immense amount of breast-wood, which, if unchecked, crowds the trees with foliage. A certain amount of leafage is necessary in order to maintain healthy root action and a sufficient flow of sap, but shoots which are not properly exposed to light and air should be removed.

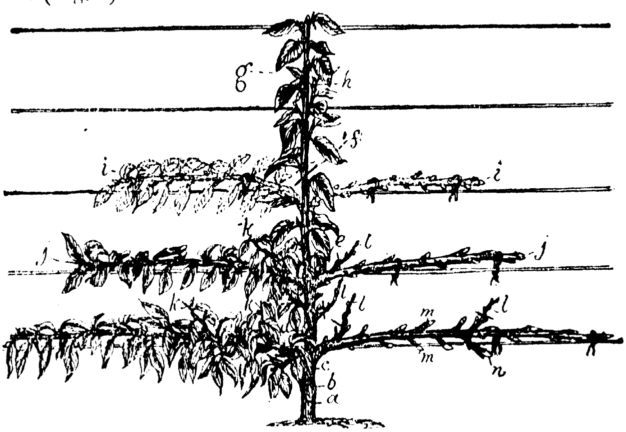
The best period for the first summer pruning is at the end of June and in July when the sun has its greatest vivifying power. The second summer-pruning may take place at the end of August and in September. Apples are much improved in colour by the admission of light at this time; and the remaining young wood is superior in quality. Most varieties of apples make their principal growth in June and July. August and September should be months of ripening—of maturation; and the latter process is greatly helped if sun and air can have free access to all parts of the tree (Fig. 6).

Most summer pruners nip or cut off the ends of the shoots from the fourth or fifth good leaf, that is, they count four or five good leaves from the base and then stop the shoot. Others merely break over the shoot, on the ground that the partial check to the sap flow serves the purpose in view without so much danger of back breaks, but this is not the best practice.

Winter Pruning.—Trees that have been summer pruned may be winter pruned at any time from November to March inclusive. Where great luxuriance of growth has been accompanied by non-flowering, the roots should be carefully pruned.

Cherries.—Heart or Bigarreau cherries are spur-bearers; the Morello is a young wood-bearer. Heart cherries should require very little pruning; indeed, it is an advantage if the knife can be kept away from them altogether, because pruning is frequently followed by an exudation of gum. If care is taken in shaping the trees while young, and the soil is not very rich, but well impregnated with lime, the trees rarely become crowded. Should they threaten to become thick the grower will be well advised to thin them while they are in leaf, immediately after the fruit is gathered, as, owing to the free distribution and vigorous circulation of the sap, gumming is not so liable to take place as is the case in winter. With the main branches thinly disposed, the trees will form fruit spurs freely and make comparatively little breast-wood. Morello cherries may be treated like peaches or they may be left unpruned altogether if they are bushes.

Pears.—An established pear tree, growing in good soil, with its main branches standing well clear of each other, may be very easily pruned, because its fruiting system is well defined. It will form spurs on the matured wood, and a considerable amount of breast-wood, which, however, is not likely to be very coarse. Summer pruning is good and may be practised as for apples. With or without summer pruning there must be winter pruning, the young wood being cut in close to the main stem or spurs as the case may be (Fig. 7).



PEAR TREE HORIZONTALLY TRAINED.

FIG. 7.—(*a*), stock; (*b*), point of budding or grafting; (*c*), scion or variety of pear; (*d*), point of heading maiden tree; (*e*), point of second shortening; (*f*), point of third (prospective) cutting back; (*g*), leading or stem growth with laterals (*h*) pinched; (*i*), side branches (prospective); (*j*), one-year side shoots or branches; (*k*), laterals pinched; (*l*), laterals marked for shortening; (*m*), spurs with blossom buds; (*n*), short shoot with bold bud at the extremity, generally a blossom bud (not to be shortened). One side of the tree is shown in leaf and the other side bare.

After many years of pruning, the spurs on wall pears sometimes increase in size to such a degree as to become both weak and unsightly. They may be crowded with fruit buds, but these are small and do not yield good fruit. In such a case the spurs may be reduced in size with great advantage, and some which are overcrowded should be cut out.

Plums.—Well-trained plum trees are very easily pruned, because when once they have developed a fruiting habit they do not make any great amount of wood. The summer shoots are generally limited, both in number and size, and it is usually only necessary to summer-prune in the case of very vigorous trees. The breast-wood may be spurred back in winter as in the case of pears. Fruiting spurs will form on the matured growth. There will also, in healthy trees,

be a considerable number of "stubs," which, in the main, may be left untouched, but may be stopped if they become elongated.

Damsons may be treated as plums, but require very little pruning when once shaped and established.

Gooseberries and Currants.—Gooseberries may be pruned in the main on the spur system, but the heaviest crops are produced by young wood thinly disposed all over the tree. Trees should have from eight to ten branches quite clear of each other, and the proper pruning consists in securing annually a good supply of young wood and *judiciously pruning it out*, cutting to spurs.

The best way of pruning an old crowded bush is to cut out some of the central branches from below, thus opening up the middle of the bush. The side branches can then be thinned.

Red currants are spur-bearers pure and simple, and may be pruned like pears. Black currants are young-wood-bearers and must not be summer pruned or spurred. The pruning must be restricted to cutting out old fruited wood.

Peaches.—The peach (with which is included the nectarine) is a young wood fruiter; that is to say, the peach bears its fruit on the long, slender side shoots (collectively described as "breast-wood") that push from the main branches, and therefore it requires a different form of pruning to the apricot, cherry and plum.

Early Pruning.—The maiden peach must be cut back severely before it starts growing the next season, otherwise it will be impossible to get a tree with a good foundation.

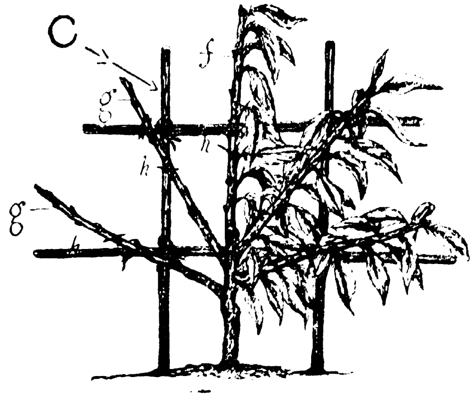


FIG. 8.—Second year peach tree:—(C). tree with five shoots, usual form of fan-trained tree, but not a true old English fan, which has no leader; (*f*), leading or central shoot; (*g*), side shoots to form branches, all others being rubbed off while quite small; (*h*). points of shortening to cause strong growths to push at the desired points.

It may be cut to five buds, and the branches resulting from the heading may all be cut back to about one-half of their length the following season. If the soil is good, and the trees are healthy, the buds on the stumps left will break very strongly, and two may be selected from each for growing on. The tree has now double the number of branches that it had prior to the shortening, and during the subsequent growing season these will extend steadily (**Fig. 8**).

At the end of the second season the third cutting back takes place, but it need not be anything like so severe as the first and second and it will suffice if the branches are shortened to the extent of one-third (Fig. 9).

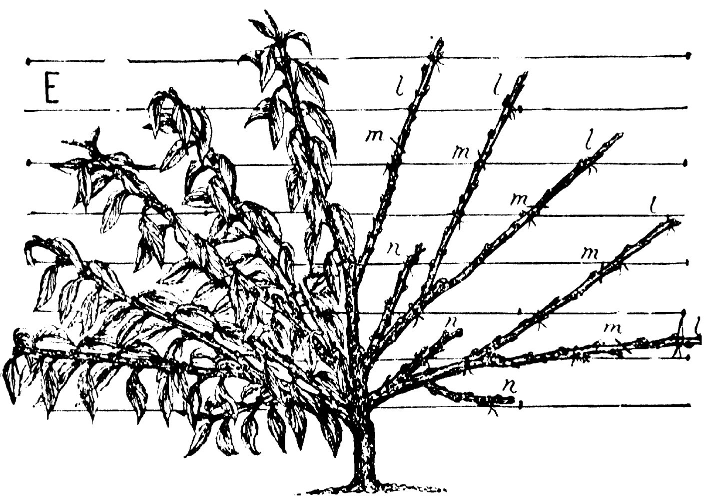


FIG. 9.—(E), third year Peach tree, fig. 8, C; (*l*). extension growths (laterals, if any, being pinched at the first joint, and at the winter pruning cut clean off to the shoot); (*m*), points of shortening the extensions; (*n*), bearing shoots, not closer than 1 ft. on the extensions, stopped at 12 to 14 in. length, and cut back to firm, ripe wood and to a wood bud at the winter pruning.

With regard to the breast-wood, the object of the cultivator is to provide an annual succession of summer shoots, in order that the growths which have borne fruit may be cut away, and their places taken by new ones.

The tying in of the summer wood should take place at the first favourable opportunity. There will probably be a great many more shoots than are required to fill the places of those cut out, and in going over the trees in order to make a selection those which stand out from the front of the

branches at right angles to the wall should first be dispensed with. As far as possible a choice should be made from amongst the shoots of medium strength that grow parallel with the face of the support.

When the shoots have matured and cast their leaves, it will be found, on examining them, that they contain different kinds of buds. There will be small, pointed, single buds, which are simply growth buds; there will probably be buds in pairs, one of which may be a plump

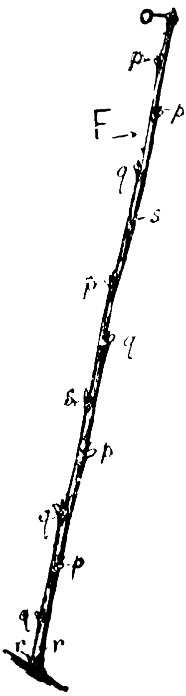


FIG. 10.—Peach. Fruiting shoot with various buds: (*o*), terminal wood bud; (*p*), triple buds (two blossom buds with wood bud in the centre); (*q*), double buds (one blossom bud and one wood bud); (*r*), basal wood buds; (*s*), wood buds without blossom buds.

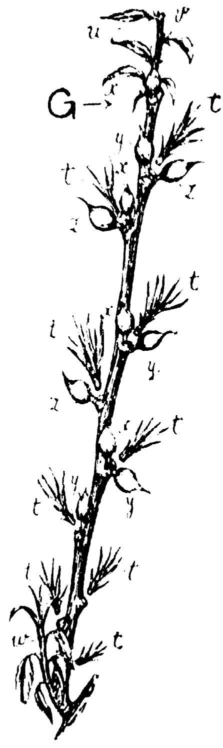


FIG. 11.—Peach. Disbudding: (G), a bearing shoot: (*t*), disbudded growths; (*u*), growth to attract sap to the fruit; (*v*), point of pinching to the third good leaf; (*w*), successional bearing shoot, not to be stopped; (*x*), fruit to be removed at the first thinning; (*y*), fruit to be rubbed off at the second thinning; (*z*), fruit left for the crop.

fruit-bud and the other a narrow wood-bud ; and there will be buds in threes, two of which are likely to be fruit-buds and the third a wood-bud. Each shoot of the right kind will contain at least one cluster of triple buds, and probably it will contain several.

Disbudding.—With the commencement of growth the following year will come the process of disbudding, which is a form of pruning. The necessity for disbudding arises from the fact that the various wood-buds on the fruiting shoots will begin to push, and if allowed to extend will soon crowd the tree and rob the fruit. The great majority of them will have to be removed, and it is advisable to nip them off while they are quite small. It is a good plan to spread the operation over a few days, in order to avoid causing a check ; indeed, such a course may be rendered imperative by the buds breaking at different periods. Two shoots may be left, one near the tip, the other at the base. The former will encourage a free flow of sap up the shoot, and so aid the swelling of the fruit. It must not, however, be allowed to extend very far ; the best thing is to nip off the end after three leaves have been formed, and if fresh growth starts stop it at the first leaf.

The basal shoot is the more important one, for it is to form the fruiting shoot of the next year, when the one now about to bear has done its duty and been cut away. It must be allowed to grow unchecked, and kept free from insects and fungi. Should it threaten to extend more than two feet the end may be nipped off, and any subsequent growths which push as a result of this pinching stopped at the first leaf (Figs. 10 and 11).

Apricots.—These must be shortened when young to secure a framework on somewhat the same line as peaches. As the wood matures it will form fruiting spurs naturally, but it will also form shoots intermediate in character between spurs and breast-wood, which are termed by gardeners "stubs." If quite short they may be left untouched ; if they run to six or eight inches long they may be stopped. In either case they will form fruit buds near the base. The breast-wood must be kept under control. Where there is room a few of the best placed of the summer shoots may be tied in, but the majority should be summer pruned and then spurred in during winter.

Cobnuts and Filberts.—The nut is a young-wood bearer ; but a framework is necessary to carry the fruiting wood, and this may take the form of a basin-shaped bush with an open centre. This form is easily secured by early shortening and selection.

Nuts are best pruned last of the various fruits, otherwise the fruiting wood may be cut away. There are two distinct forms of inflorescence on the same tree—the catkin or male flower, and the fruiter or female. Both are borne on the wood made the previous year. The catkin is long, tapering, and brownish-yellow in colour. The female is pink, and breaks like a little rosette from the tops of the plump fruit buds. The side shoots on the older wood should be examined in turn. Some may be natural spurs, with a wood bud at the tip and a fruit bud at the base; these may be left unshortened. Others (and these the majority) will be shoots several inches long, with fruit buds and catkins. These shoots may be pruned to a catkin a few inches from the base. Old fruited wood may be cut out.

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Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 253.

BOARD OF AGRICULTURE AND FISHERIES.

Microsporidiosis of Bees, or Isle of Wight Bee Disease.

In recent years the attention of bee-keepers has been drawn to a virulent disease of bees, which has received the popular name of Isle of Wight Disease, from the fact that it was first observed in that island. The disease, however, has spread to many parts of Great Britain, and is also prevalent in other parts of Europe, in America and in Australia. It is caused by a microscopic animal parasite consisting of a single cell, which is present in vast numbers in the walls of the chyle-stomach and intestine of diseased bees, and bears much the same relation to the higher forms of animal life that a bacillus bears to the higher forms of plant life. This protozoon has been given the name of *Nosema apis*, Zand., and, as it belongs to the group called the *Microsporidia*, the disease has been named *Microsporidiosis*.

During its short life the *Nosema apis* passes through three stages. First, on emerging from the spore, it is known as a "planont," on account of its capacity to move from place to place; during this stage it wanders in search of a convenient cell in the body of the bee which it can penetrate. As soon as it has entered a cell, the parasite loses its capacity to move and passes into the second stage of its life history, when it is called a "meront." During this stage it feeds, grows, and multiplies enormously, and after a series of changes, each daughter form becomes a spore. The spore is the third form of the *Nosema*, and it is in this form that the parasite spreads from one colony of bees to another. The spore has a hard protective coat and is about one-thousandth of the size of a grain of rice, which it resembles in shape. Both planonts and meronts can increase in number by division, though the meronts have a greater capacity in this direction than the planonts. The rate of increase is important, since there is reason to believe that the virulence of the epidemic depends on the circumstances which favour the rapid increase or otherwise of the *Nosema* in the intestine of the bee. Further, it should be noted that it is the increase in numbers that causes illness in the infected bee.

The symptoms of the disease are so variable that until recently *Microsporidiosis* has been referred to under several different names. In its least harmful form it develops slowly and kills very few bees, while the colony is often replenished by the young bees that emerge from the brood. In this form it is popularly known as "spring dwindling," and

frequently escapes the notice of all but expert bee-keepers. In other cases the disease is diagnosed as "starvation." The loss of foragers causes a diminution in the income of food supplies, and eventually the colony dies from starvation. The combs, if subsequently made use of, may start the disease at indefinite intervals. In other cases it causes acute diarrhœa, and is known as "malignant dysentery." In its most malignant form it is known as Isle of Wight Disease, but even in this case there are two distinct degrees of virulence, the milder, when the bees live long enough for the meronts to turn into spores which are capable of spreading the disease to other colonies, and the more malignant form when the bees die before the parasites have fully developed into spores. All these ailments are, however, due to *Nosema apis*, and should be treated as cases of *Microsporidiosis*, since, as a rule, no bee that has once been infected ever recovers, though it may live a considerable time in an apparently healthy state. Those infected bees which survive the longest are known as "parasite carriers" and help to spread the infection among more susceptible colonies.

From this statement it will be seen that there are no symptoms that can be absolutely relied upon as diagnostic of *Microsporidiosis*, even in the form known as Isle of Wight Disease, except the sudden and otherwise unaccountable death of large numbers of bees in a colony. Occasionally, even the expert finds it difficult to detect the presence of *Nosema apis* in a sick bee. For practical purposes there are, however, certain symptoms which should not be overlooked or neglected. As a rule bees which are attacked are apparently perfectly healthy when packed away for the winter, but on examination in the early spring are found to have all died, though well supplied with food and well protected from cold and damp. This is perhaps the commonest form of the disease, and bee-keepers should be prepared for it and take measures to disinfect the hives at once. Colonies are, however, often attacked at other seasons, and different symptoms are then noticed. One correspondent observed in his apiary two forms of the disease which he describes as follows:—

"The disease in my apiary of 23 hives seemed to have two forms. In Form No. 1, the bees began by clustering on the hive front, and in five days spreading out on the ground unable to take wing, and creeping back into the hive towards evening, though many of the older-looking were left on the grass to chill and die, and so they dwindled thus for two or three months till only a few young bees and the queen remained. In Form No. 2, which began later (in November), I suddenly found 11 hives with their bees and queen in a heap on the floorboard, and little or no outward sign. There was

little or no soiling and plenty of stores with hives dry and snug." In connection with the first form here described, several symptoms have been reported by observers.

(1.) The bees lose their power of flight. This again may be gradual or sudden. Bees have been observed to collapse while on the wing. In other cases they have been noticed to fly heavily, or to progress by means of short flights of a few yards. Again they have been described as apparently surprised at their inability to take wing, and are said to jump forward and tumble down when they leave the flight board. In other cases they seem well aware of their difficulty, and climb to the top of the hive as though seeking a better position for the start. They often climb up stems of grass, apparently with the same purpose. Their inability to fly is probably due to weakness and the extra weight of the body caused by the overladen abdomen, and not to any paralysis of the muscles. On the other hand there is evidence that the inability to void their excreta is due to their inability to fly. It has frequently been observed that the wings stand out from the body in an abnormal manner. Sometimes the anterior wings and sometimes the posterior wings are thus distorted; occasionally one wing only is affected. But though this symptom is very commonly found, it is doubtful if it can be considered really diagnostic of the disease.

(2.) The bees sometimes lose the use of one or more pairs of legs. Sometimes the bees "drag their hind legs," though the anterior pair and even the middle pair may be more or less vigorous. Sometimes, however, they are able to "run rapidly" and have the full use of their legs even when unable to fly.

(3.) The abdomen is generally distended and appears to hang down at the hinder end. This, however, is the result of an inability to take the cleansing flight, and is observed in all such cases, even though no disease is present.

(4.) Sometimes the bees are very vicious and use their stings freely; sometimes they are very gentle and allow themselves to be handled.

(5.) Sometimes the affected bees appear to lose control of the sphincter muscles of the bowel, and the combs and hive parts are soiled with excrement. Dysentery should always be looked upon with suspicion, though it is sometimes caused by yeast-like organisms, which set up fermentation in the contents of the bowel. Cases have also occurred in which no soiling of the hive or combs was noticed. While, therefore, soiling is a common symptom, its presence or absence must not be necessarily regarded as conclusive.

(6.) The bees die sometimes in the hive, sometimes on the alighting board and the ground round the hive. At times

they disappear altogether, and their bodies cannot be found anywhere in the neighbourhood.

There are, however, certain other indications which, taken in conjunction with one or more of the symptoms described above, especially the sudden death of large numbers of bees in a colony, warrant the bee-keeper in thinking that his bees are possibly attacked by *Microsporidiosis*.

(7.) The foragers are generally the first to be attacked, though in some cases the drones have been noticed as the first to succumb to intestinal infection. The loss of the honey gatherers, which is not always noticed by the bee-keepers, may account for the unusually early slaughter of the drones, which has been mentioned as a first sign in some cases. This slaughter may in its turn explain the view held by some observers that the drones are not affected, since any drones remaining in the apiary would belong to healthy stocks.

(8.) The queen is usually the last to die, and is frequently found in an almost empty hive with a few bees clustered around her. It is not true, however, that the queen bees are immune, and *Nosema* has been found in queens from diseased hives.

(9.) A swarm will often succumb while the bees left in the hive will remain apparently healthy for some considerable time. On the other hand the continual loss of the working bees and the complete absence of swarming may be a sign that disease is present. Such apiaries are probably the endemic centres from which the disease spreads.

Bee-keepers who notice any of the above-named symptoms, or indeed who notice any general indication that their bees are disinclined to work, should at once examine their hives to ascertain if *Microsporidiosis* is present, and if they are in doubt should at once consult an expert. If no local expert is available, they should communicate with the Board, describing as fully as possible all the symptoms they have noticed. It is useless, however, to send up any bees whether alive or dead, unless asked to do so. It is not possible as a rule to express any opinion from an examination of dead bees.

The names of Maypest (French *Mal de Mai*, Italian *Mal de Maggio*, German *Maikrankheit*), Bee Paralysis and Dysentery are probably often applied to the less virulent forms of the disease. The symptoms of these diseases are described in the following terms :—

Bee Paralysis.—"In the early stages bees will be noticed, with abdomen much swollen and of a dull black appearance, running from the entrance and about the alighting board, and in doing this they frequently fall on to the ground. Later some are seen trembling or shaking, with wings bent

up in an unnatural position. On opening a hive, bees in a similar condition will be found running about; but sooner or later they work their way to the entrance and perish in a few hours after falling to the ground. It also not seldom disappears as suddenly as it comes." (Cowan, *British Bee-keepers Guide Book.*) It is, however, improbable that bees once attacked ever recover. They usually act as parasite carriers.

Maypest.—"As in paralysis, bees will be seen coming from the hive and running about the alighting board from which they drop to the ground, being unable to fly. They crawl about the ground, some ascending blades of grass to gain an eminence from which to take wing, but in every attempt fall to the ground again. They will also be seen towards evening gathering in clusters for warmth, but most of them die during the night from exposure. Any survivors usually succumb next day. The disease attacks indiscriminately bees young and old, and the abdomen of those affected appears slightly inflated, the whole body being covered with a light grey dust." (Cowan, *op. cit.*)

Betrand, however, regards Maypest and paralysis as interchangeable terms, and cases of paralysis have occurred in America where no trembling of the limbs has been noticed. It is doubtful too if the light grey dust is always present. It is safe to regard all these diseases as less virulent forms of Isle of Wight Disease.

Remedial and Preventive Measures.

Until recently no certain remedy had been discovered for *Microsporidiosis*, most cases of so-called cures that have been investigated being based on faulty observations. A few recommendations, however, can be given for preventing the spread of disease, and for mitigating its severity when it appears.

1. *Cleanliness.*—Great care should be taken to keep the hives and the surroundings of the apiary clean. Cleanliness will not in itself secure immunity from disease, but dirty surroundings lower the vitality of the bees and render them more liable to attack. All bee-keepers who can give the necessary time to their attention should adopt standard bar frame or moveable comb hives, but those only able to use skep hives should renew them every two or three years.

After an outbreak of disease, all moveable comb hives should be charred with a painter's lamp as advised in the text-books. They should not be used again for several weeks. All skeps, quilts, combs, honey, and all bee appliances that have been used in connection with the affected colony, should be burnt, together with all dead bees, and the soil round the

hive should be turned over and sprinkled with paraffin and then dug over and covered with quicklime.

2. *Drinking water.*—Water is required by bees at all times when they can leave the hive, though only sufficient is taken in to serve the needs of the colony for a short time. According to Pettigrew a great deal of water is carried into a hive at the height of the breeding season. It is collected, on dewy mornings and after showers, from the blades of grass and the leaves of other plants. When the weather is dry, bees resort to streams and ponds, certain selected spots being made use of. They often resort to dirty pools of stagnant water rather than take clean but colder water. In showery weather, water is probably a greater source of infection than in dry weather. The bright intervals which permit the gathering of water are also utilised for cleansing flights by many bees. Since the excrement of infected bees is often full of spores, many of the puddles and drops must be highly contaminated when infected bees are present. Two remarkable cases illustrate the danger from this source:—(1) The enormous losses in certain apiaries were believed to be due to a small fishpond in an adjoining garden. Its shallow water soon got warm and it was covered, especially in the spring, with green algae which gave the bees an easy opportunity of drinking. When the pond was removed there was a great diminution in the disease. (2) The bees of an apiary in a highly infected area remained healthy. It was found that they were in the habit of gathering chemically polluted water from the effluent of a gas works. The disease only appeared among them when, owing to alterations, they were compelled to gather water from other sources.

Bee-keepers should, therefore, endeavour to see that no stagnant water is left in the neighbourhood of their apiaries, especially when there is any disease in the neighbourhood, and should endeavour to supply their bees with a pure supply at a short distance from the hive. In the spring very thin syrup could be given in the ordinary feeders, as this lessens the demand for water. Some authorities advise supplying them with salt water, especially in the spring.

3. *Movement of Bees.*—It need hardly be said that bee-keepers who live in districts which are free from disease, should on no account purchase swarms or driven bees from an infected district. There is no surer way of spreading disease than to transfer bees from one district to another, for swarms even from apparently healthy stocks sometimes develop disease when placed in new hives. It is probable that all the parasites have not the same degree of virulence, and that the passage of the parasite through successive bees may increase its virulence. It is, therefore, important to prevent the disease being spread by parasite-carriers, that is

bees in which the parasite is present, without causing the disease to develop its normal course. These parasite-carriers may be divided into two classes: (1) those which have come in contact with diseased individuals, and have in some way acquired the organisms without contracting the disease; and (2) those which have suffered from the disease often in a slight and modified form, and have continued to harbour the organisms for long periods subsequently.

Either of these classes of parasite-carriers may spread disease if brought into contact with susceptible stocks, so clearly it is equally dangerous to introduce bees from a disease-free district, into a neighbourhood where disease abounds. Bee-keepers in such districts therefore should, if they wish to acquire fresh stocks, purchase them in the immediate neighbourhood where there is a possibility that the bees are capable of resisting any infection with which they are likely to come into contact.

4. *General Management.* — Finally, bee-keepers must remember that much may be done by careful and proper management of their apiaries. It cannot be stated too emphatically, that the production of disease depends on many important factors besides the mere introduction of the infecting agent, though of course, disease cannot arise unless *Nosema* is introduced. Every infected bee dies sooner or later from the disease, but parasites sometimes occur in small numbers and reach the spore stage without apparently affecting the health of the bee. Old spores from long dead bees seem to be less virulent than fresh spores, and there is some reason for thinking that while unsuitable food, and damp or unhealthy conditions, are favourable to the increased virulence of the parasite, suitable food and conditions increase the natural resistance of the bee, and, at least for a time, keep the symptoms of the disease in check. Requeening at regular intervals, if practised systematically, is a valuable aid in combating disease.

New Treatment for Microsporidiosis.—Recent research has led to the discovery of two drugs, which, if fed to the bees with syrup or candy, will cause slightly infected bees to void the parasites, or will destroy them in the stomach and intestine before serious injury is done to the constitution of the insect. At present all that can be said with certainty is that individual colonies have been treated with success, but experiments are now being carried on with the object of seeing whether a more extended treatment will be equally successful. It has been found that for purposes of treatment the history of the disease may be divided into five periods or degrees of intensity, according to the number and stage of the parasites present. In the first two of these, when the parasites are still few and in the young stages

(planont or meront), there is reasonable hope of success. In the third there is still slight hope, but in the last two the infected bees are doomed. Unfortunately during the first stage the bees seldom if ever display any symptoms observable by the naked eye; in the second stage, the symptoms are slight, and when symptoms are noticed by the ordinary bee-keeper it is generally too late. At present, therefore, the dissection and microscopical examination of a sample of bees from the suspected colony is necessary before any opinion can be expressed or the drug applied with any hope of success.

Microsporidiosis is also dealt with in Supplements to the *Journal of the Board of Agriculture*, Vol. xix., No. 2, May, 1912, and Vol. xx., No. 4, July, 1913. These supplements are obtainable from the Office of the Board, price one shilling, and 9*d*., post free, respectively.

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Leaflet No. 254.

BOARD OF AGRICULTURE AND FISHERIES.

The Use of Seaweed as Manure.

All around the coasts of the British Isles and of other countries in northern Europe seaweed has a high reputation as manure. There is no record or even any tradition to show when it was first used, or how its value was discovered, but it seems to be essentially a northern manure, and began to be mentioned as soon as descriptions were written of the husbandry of the coast districts.

Scotland.—In Scotland, the right of gathering seaweed still sometimes forms part of the covenant with the landlord, and has even been the subject of litigation. It appears to be held in special favour on the south-west coast, where there is a good deal of light soil, and cartage presents no particular difficulties; indeed, it is perhaps the chief manure used for early potatoes on the Ayrshire coast, being applied at the rate of 25 to 30 tons per acre in autumn, and then ploughed in. The seaweed gathered in summer is put on top of the "middens" till wanted. Farther up the west coast, and also on some of the islands, seaweed is used by the crofters, but it does not appear to be held in so much favour on the east coast, excepting where it can very readily be obtained.

Cornwall and Devon.—Seaweed is still diligently collected in the west country; the amount available is, of course, very variable, and most comes into the bays facing south and south-west—the direction of the storms. In the market gardening regions of south Cornwall it is not, as a rule, used in the fresh condition, but is mixed with calcareous sand as of old and allowed to rot. It is then applied along with guano and superphosphate for early potatoes and cauliflowers. Elsewhere it is used for the root crops. The material usually collected appears to consist of *Fucus serratus*, *F. vesiculosus*, and, after stormy weather, *Laminaria digitata*. Near some estuaries *Ulva lactuca* is gathered.

On the north Devon coast seaweed is used for potatoes and roots; so much is it esteemed as a spring dressing that a certain amount is sent by barges to points inland for the use of farmers too far from the sea for cartage to be profitable.

Scilly Isles.—The light soils of the Isles of Scilly are very dependent on a supply of organic matter to retain moisture; as much as 50 tons of seaweed per acre is, therefore, applied for early potatoes, nearly as much for mangolds and other roots, but smaller dressings are put on for corn. A certain amount is also allowed to rot in piles, and is then used for bulb cultivation and general garden purposes. *Fucus serratus* is most popular, and has the highest reputation, whilst the thick fleshy strands of *Laminaria* are least esteemed; indeed, it is considered that the latter injure the soil if used too freely. The weed is generally gathered between September and March, and is by far the most important fertiliser in the Islands.

Isle of Thanet.—In the Isle of Thanet it is used in several ways. The fresh weed is spread at the rate of ten to fifteen tons per acre over lucerne or sainfoin in the early autumn, and the residue raked off in spring just before the crop starts. It is also put on the land at the rate of ten to fifteen tons per acre before ploughing, and is found to be very beneficial to such market-garden crops as cabbage, celery, asparagus, &c., as well as the ordinary farm crops. Some is also thrown into the dung midden. Normally, however, it is collected only when other work can be left, the reason probably being that cartage is heavy. A load weighs about a ton, and often requires two horses to get it from the shore; the enormous quantities thrown up by high tides when the wind is from the north or north-east—making a fringe along the high-water mark which may be three or four feet in thickness—sometimes prove more than the market gardeners and farmers on the coast can profitably use.

Jersey.—In Jersey not only is the "drift weed" cast up by the tides collected, but seaweed is also cut from the rocks. As much as 45 tons of the fresh seaweed are applied per acre soon after the crop following early potatoes is out of the way, commonly about the middle of September. Later in the season recourse may be had to seaweed that has been collected, dried, and stacked, this being a regular summer occupation for some of the poorer people of the island. Little if any deterioration seems to set in, if the weed is quickly dried and not exposed to rain, while the saving in cartage is considerable. Ploughing and digging-in takes place in December and January, and planting with early potatoes follows as soon as practicable. From two to four cwt. per acre of a complete artificial manure are usually given in addition.

Other Localities.—Seaweed is largely used on the Irish coast and on the French coast; at Mont St. Michel there is a considerable trade in seaweed as manure. It is also of great importance in some of the New England coast districts.

Species of Seaweed used as Manure.

Although many different species of seaweed may be represented in the material collected for use as manure, by far the greater proportion consists of species of *Laminaria* (chiefly *L. digitata*) and *Fucus*.

Laminaria.—This kind of seaweed, which is popularly known as "drift-weed," "May-weed," "tangle," "kelp," or "ore-weed," is usually found in comparatively shallow water below low water mark. It consists of a stem and a broad flat frond or lamina; the stems preponderate in seaweed collected in winter and the fronds in that collected in spring. Although the stems contain a higher percentage of moisture than the fronds, they also contain a higher proportion of potash, and this characteristic is naturally emphasised if the dry matter only is considered. On an average the dry stems contain from 10 to 12 per cent. of potash, while the dry fronds contain only about 5 per cent. The ash obtained by burning *Laminaria* may contain from 20 to 30 per cent. of potash.

Fucus.—The commonest species of *Fucus* are *F. vesiculosus*, *F. nodosus* and *F. serratus*. This kind of seaweed is known locally as "wrack," "black-wrack," "bladder-wrack," or "cut-weed," and is usually found between tide marks. Compared with *Laminaria* the potash content of the different species of *Fucus* is low; when dried they do not contain more than 3 or 4 per cent. of potash and, if burnt, the ash contains on an average little more than 12 per cent. On the other hand, *Fucus* may be collected on many parts of the coast, including sheltered waters, from which no great quantities of *Laminaria* can be conveniently obtained, and may also be gathered or cut from the rocks at low tide, whereas *Laminaria* must be washed ashore by tides or storms, or be cut and gathered from a boat.

Among other species of seaweed collected may be mentioned *Ulva lactuca* ("green laver" or "sea lettuce"), *Zostera*, *Glyceria* and *Salicornia*. In general, these are distinctly poorer in composition than *Laminaria* or *Fucus*, and contain a certain amount of fibre which does not readily decompose when they are used as manure.

The following analyses* will show the average manurial value of the more important species of seaweed :—

Fresh and Dried Seaweed.

—	Water.	Organic Matter.	Nitrogen.	Potash.
Fresh Seaweed :—	%	%	%	%
Laminaria digitata (stems) "Drift-weed," "Tangle," &c.	82·37	12·31	0·23	1·83
" " (fronds)	74·75	19·59	0·34	1·28
Fucus vesiculosus (" Wrack."	68·17	25·29	0·38	·97
" *nodosus* " Bladder-	70·52	23·13	0·33	·78
" *serratus* Wrack," &c.)	75·40	19·08	0·36	1·02
Dried Seaweed :—				
Laminaria digitata (stems)	—	64·03	1·31	10·49
" " (fronds)	—	77·28	1·30	5·25
Fucus vesiculosus	—	79·71	1·18	3·07
" *nodosus*	—	78·39	1·13	2·52
" *serratus*	—	77·56	1·50	4·18

Average Potash Content of Ash.

—	L. digitata (stems).	L. digitata (fronds).	F. vesiculosus.	F. nodosus.	F. serratus.
	%	%	%	%	%
Potash in Ash	28·71	20·99	15·29	12·22	18·60

Value as Manure.—Seaweed contains about as much nitrogen as farmyard manure, but, as it is present as slow-acting organic nitrogen, it is scarcely so valuable as in average dung in which a certain proportion is present in the active available form of soluble ammonia compounds. As the seaweed decays rapidly in the soil, however, some of its nitrogen soon becomes available. The amount of phosphate in seaweed is only about ½ or ⅓ that of dung ; on the other hand, seaweed is on the average considerably richer in potash. It will be seen, therefore, that it is desirable as a rule to supplement it with a phosphatic manure. Seaweed contains no fibre, and, consequently, does not produce the black fibrous material characteristic of the dung heap ; in decomposing it forms soluble substances which easily wash away. For the same reason it decomposes more completely than dung. It is even said to facilitate the decomposition of dung on light soils and in dry districts, but there is no definite proof of this. A ton of dung and seaweed would break down in the soil more quickly than a

* From analyses carried out by Hendrick.

ton of dung alone, and would therefore have less of a drying effect if put on late. The freedom of seaweed from weed seeds and from spores of disease organisms is of considerable advantage on light soils where weeds are common, or on soils liable to such diseases as finger-and-toe, the spores of which can hardly be kept out of dung.

Experiments to test the manurial value of seaweed have been made at Trondhjem, at the Rhode Island Experiment Station, and by a few workers in Great Britain. In Hendrick's trials seaweed proved fully as effective as dung for early potatoes so far as quantity of produce was concerned, but it somewhat retarded ripening. On the other hand, seaweed and superphosphate proved better than dung and superphosphate. It is, however, on such gross feeding crops as mangolds and the cabbage tribe that seaweed would be expected to show its fullest effects.

Reference has already been made to the fact that seaweed decomposes more completely than dung, and is converted into soluble or gaseous substances. It should therefore not be allowed to rot in heaps by itself, but should be put straight on to the land, or, if this is not practicable, mixed with dung or other material which will absorb some of the decomposition products. The value of a heap of seaweed is much lessened by exposure to rain, but exceptions to this rule may arise in the case of special garden crops.

Use of Dried Seaweed and Kelp as Manure.—Fresh seaweed is of too bulky a nature to bear carriage over any great distance inland, and, in view of its value as a source of potash, it is important to ascertain whether it can be economically dried and ground or converted into kelp. With potash at its present price it is possible that, where large quantities of *Laminaria* are available, drying and grinding of seaweed would prove profitable, and even in normal times the product might be worth consideration as a constituent of manure mixtures. The potash content of *Fucus* is too low to render it of much value for this purpose.

Even if iodine were neglected it would perhaps pay well to burn both *Laminaria* and *Fucus* with a view to using the ash as a potassic manure. The ash obtained from *Fucus* would be at least as valuable as kainit, while that from *Laminaria* would be much more so. The seaweed used for burning should be free from sand, and during the process of drying should be exposed as little as possible to leaching by rain water. In burning violent heating should be avoided.

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Leaflet No. 255.

BOARD OF AGRICULTURE AND FISHERIES.

The Workmen's Compensation Act, 1906.

The Board think it may be useful to publish in the form of a leaflet certain portions of a memorandum on the Workmen's Compensation Act, 1906, which has been prepared by the Home Office.* The main provisions of the Act as affecting agriculturists are stated in plain language, but this brief summary must not be taken as rendering unnecessary a careful study of the provisions of the Act itself.

1. *The Object of the Act.*

The object of the Workmen's Compensation Act, 1906, is to make some provision for employees who, through accidents arising out of and in the course of their employment, are disabled from earning their ordinary wages, or if the accident results in death, for any persons who are dependent upon the deceased. To effect this object, the Act makes *the employer* liable to pay compensation for such accidents. If the accident causes permanent or temporary disablement, the compensation will be in the form of weekly payments to the injured person while the disablement lasts; if the accident results in death, the compensation will be a lump sum to be applied for the benefit of such members of the family of the deceased as were dependent upon his earnings at the time of his death.

The Act does not require employers to insure against these liabilities, but it is advisable that any employer who would find it difficult to meet the heavy charge which might be entailed upon him by a serious accident, should protect himself by insurance with a sound insurance company.

2. *Injuries to which the Act applies.*

There are two classes of injury for which compensation is payable under the Act: (1) injury by accident; (2) injury to health from industrial disease. As regards injuries by accident the Act lays down the following conditions:—

(*a.*) The accident must arise out of the employment, *i.e.*, it must be directly due to the injured person's employment, and it must *also* happen in the course of the employment.

(*b.*) The injury must disable the injured person for a period of at least one week from earning full wages at the work at which he was employed.

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* "Memorandum on the Workmen's Compensation Act, 1906," issued by the Home Office, to be obtained on application to the Home Office, London, S.W.

(*c.*) If the injury is proved to be due to serious and wilful misconduct on his part, no claim to compensation is to be allowed unless the injury results in death or serious and permanent disablement.

The word "accident" has been interpreted by the Courts in a wide sense, the House of Lords defining it in a case under the Act of 1897 as "an unlooked-for mishap or untoward event which is not expected or designed" (*Fenton* v. *Thorley*, 1903, A.C. 443).

3. *Persons entitled to Compensation.*

The Act applies to any "workman," but the term "workman" is used in a special sense, being defined to mean "any person who has entered into or works under a contract of service or apprenticeship with an employer, whether by way of manual labour, clerical work, or otherwise, and whether the contract is expressed or implied, is oral or in writing." This definition is very wide and may be said to cover every case in which two people stand to each other in the relation of master and servant. But a few classes of persons are by the Act expressly excluded. Among these are the following :—

(*a.*) Persons not employed in manual labour whose remuneration exceeds £250 a year.

(*b.*) Any person whose employment is of a casual nature and who is employed otherwise than for the purposes of the employer's trade or business.

It may be difficult in particular cases to say whether a workman who has been given a casual job, has or has not been employed for the purposes of the employer's business; but, as a rule, the question should be easily answered. For example, the extra hands whom a farmer engages for haymaking or harvesting are employed casually, but their employment is for the purposes of the farmer's business, and they will therefore come within the Act.

(*c.*) A member of the employer's family dwelling in his house.

When the workman dies as a result of the accident, the "dependants" who will be entitled to compensation will be such members of his *family* as were wholly or in part dependent upon his earnings.

"Family" includes : wife, husband, father, mother, grandfather, grandmother, step-father, step-mother, son, daughter, grandson, granddaughter, step-son, step-daughter, brother, sister, half-brother, half-sister.

4. *The Person liable to pay Compensation.*

In the case of injuries by accident, the person liable to pay compensation is the employer, and he continues liable

when he temporarily lends or lets on hire the workman's services to another person. The liability of the employer is not affected by his having insured against claims under the Act; in the event of an accident he and not the Insurance Company (except in the circumstances specified below) is liable to pay compensation, and it is to the employer that the claim must be made.

Special provision is made in Section 4 with regard to *sub-contracting*. Roughly, the effect of the section may be said to be that where the workman is engaged on work which has been sub-let to his employer by another person, called in the Act "the principal," the workman is given the option of claiming compensation either from his own employer or from the principal.

An exception is made to the above rule in the case of certain contracts for agricultural work. Where a person contracts with a farmer to do threshing, ploughing or other agricultural work, and, in order to execute the work, provides and uses machinery driven by mechanical power, he alone will be liable to compensate the workmen whom he employs. No claim can be made against the farmer by the contractor's workmen.

Special provision is also made (*see* Section 5) for securing to the workman, in the event of the employer becoming bankrupt, the benefit of any policy of insurance which the employer may have effected against his liabilities under the Act, and also for giving a certain preference, in the distribution of the employer's property, to claims for compensation under the Act. The terms of the section should be consulted.

5. *Amount and Payment of Compensation.*

(1.) *Injuries resulting in death*:—

(*a*) If the workman leaves any person wholly dependent upon his earnings, the compensation is to be £150 or three years' earnings, whichever is the larger, up to a maximum of £300.

By "three years' earnings" is meant the amount earned by the workman in the employment of the same employer during the three years immediately preceding the injury, or if the workman has been employed less than three years, a sum equal to 156 times his average weekly earnings in that employment.

If some time elapses between the date of the injury and the date of death, any compensation paid to the workman in the interval is to be deducted from the amount due to the dependants.

(*b*) If the workman leaves persons partially dependent, the compensation is to be such sum, not exceeding the amounts specified under (*a*), as will be reasonable and proportionate to the loss sustained by the dependants.

(*c*) If no dependants are left, then the reasonable expenses of medical attendance and burial are payable up to a maximum of £10.

It is important to notice that in all cases in which dependants are left, the compensation must not be paid by the employer direct to the dependants, but must be paid into the county court.* The court will invest, apply or otherwise deal with the money in such manner as it thinks best for the benefit of the dependants.

(2.) *Injuries resulting in disablement*:—

(*a*) If the workman is *totally* disabled, the compensation will be a weekly payment while the disablement lasts, which is not to be more than half his weekly average earnings, or to exceed £1.

No compensation is payable for the first week if the disablement lasts less than two weeks.

No compensation is payable at all for injuries which last only a week or less.

(*b*) If the workman is only *partially* disabled, the weekly payment must not exceed the difference between what he was earning before the accident and the amount he is earning (or is able to earn in some suitable employment or business) after the accident, but is to "bear such relation to the amount of that difference as under the circumstances of the case may appear proper." Thus, if a workman who has been earning £2 a week gets £1 a week compensation while totally disabled, the £1 must be reduced to at least 10s. as soon as he is so far recovered as to be able to earn 30s. in a suitable employment. Otherwise his compensation and weekly earnings together would amount to more than the £2 which he was earning before the accident. If, however, he only recovers sufficiently to earn £1 a week, no definite rule is laid down as to reducing the amount of compensation; the amount will be a matter to be settled by agreement between the parties or by the arbitrator, according to the circumstances of the case.

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* **In Scotland, the Sheriff Court.**

In fixing the weekly payment, any payment, allowance or benefit which the workman may receive from the employer during his incapacity is to be taken into account.

Several rules are laid down (*see* Schedule I., paragraph (2)) to afford guidance in cases where difficulty arises in the determination of what were the "earnings" and "average weekly earnings" of the workman.

There is a special scale in the case of a workman who is under 21 years of age at the time of the injury. If his average weekly earnings were less than £1, the weekly payment awarded may be any sum up to 10s., *e.g.*, if his wage is 14s., he may under this scale get 10s. instead of 7s. a week. Further, if the disablement lasts more than twelve months, the weekly payment may be increased, on the application of the workman, to half the weekly sum which he would probably have been earning at the time of the application if he had remained uninjured, subject to a maximum of £1.

A workman permanently disabled by an injury may, if he ceases to reside in the United Kingdom, have his compensation paid to him by quarterly remittances.

6. *Proceedings for Settlement of Claims.*

An injured workman desiring to obtain compensation must give formal notice of the accident to his employer, and make a claim on the employer for compensation.

The *notice* must be sent to the employer *in writing* as soon as practicable after the accident happens and before the workman has voluntarily left the employment; it should give the name and address of the workman, and should state in ordinary language, the cause of the injury and the date on which the accident occurred.

The *claim* for compensation must be made *within six months* from the date of the accident, or, in case of death, within six months from the time of death.

After notice of an accident has been given, the workman must, if so required by the employer, submit himself for examination by a doctor provided and paid by the employer. If he refuses, his rights under the Act are to be suspended till the examination has taken place.

All claims for compensation may be settled by agreement between employer and workman, and, excepting in cases of death, the compensation may be paid by the employer direct to the workman.*

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* Under a Convention made with the French Government, claims by French citizens cannot be settled by agreement but must be brought before the County Court Judge (in Scotland the Sheriff).

If the claim is settled by agreement, a memorandum of the terms of the agreement is to be sent to the *registrar of the county court for registration. When registered, the agreement becomes enforceable as a county court judgment. In cases where an agreement is made, either in the first instance or subsequently, for payment of a lump sum down instead of weekly payments, the agreement will not relieve the employer of his liabilities to make weekly payments, unless it has been registered.

In the case of accidents to persons insured under the National Insurance Act, the employer is required to send notice to the Insurance Commissioners of any agreement (1) as to compensation when the amount agreed is less than 10s. a week, or (2) as to the redemption of a weekly payment by a lump sum. The notice must be sent within seven days after the making of the agreement, and must contain the following particulars :—

Full name and address of employer.
Full name and address of workman.
Business of employer.
Nature of occupation of workman.
Average weekly earnings of workman.
In case of personal injuries caused by accident—
  Nature of the accident.
  Place of the accident.
  Date of the Accident.
In case of industrial disease contracted by the workman—
  Nature of the disease.
  Date of the disablement or suspension of the workman.
Date of the agreement to which notice relates.
Amount of the lump sum or weekly payment.
In the case of a lump sum payment—
  Age of the workman,
  Amount of weekly payment redeemed.
  Estimated duration of incapacity of workman.

To prevent agreements being made for lump sums which are unfair to the workman, the Court is now given power, if it thinks that an agreement ought not to be registered by reason of the inadequacy of the sum, or by reason of its having been obtained by fraud or undue influence or other improper means, to cancel the agreement or make such other order as it thinks just. In the case of persons insured under the National Insurance Act, the Court has this power in regard to *any* agreement between the employer and the insured person as to the amount of compensation.

In default of agreement, a claim for compensation can be settled in one of the following ways :—(1) by proceedings in

* In Scotland, the Sheriff Clerk ; in Ireland, the Clerk of the Peace.

the *County Court; or (2) by arbitration before a private arbitrator, agreed to and appointed by the parties; or (3) if a committee, representative of the employer and his workmen, exists with power to settle matters under the Act, by arbitration before such committee.

If a person insured under the National Insurance Act unreasonably refuses or neglects to enforce a claim to compensation under the Compensation Act, the Insurance Committee or approved society concerned may itself take proceedings to recover the compensation.

7. *Contracting-out.*

Any agreement entered into between an employer and workman by which the workman, in the event of disablement, is to receive no compensation or less than he is entitled to under the Act, is worthless. The workman cannot be deprived of or give up his rights under the Act. The only "contracting-out" which is allowed must take the form of a scheme of compensation agreed to between an employer and his workmen (or a majority of his workmen), and certified by the Registrar of Friendly Societies. Such a scheme must, amongst other things, provide scales of compensation not less favourable to the workmen and their dependants than the corresponding scales contained in the Act. For further information as to such schemes, application should be made to the Registrar of Friendly Societies, 28, Abingdon Street, London, S.W.

The Act further makes provision for the review and redemption of weekly payments, the settlement of disputes by medical referees, and the award of compensation in the case of industrial diseases, *e.g.*, anthrax and glanders. For fuller information on these points reference should be made to the Home Office Memorandum on the Act (which may be obtained on application to the Home Office), or to the Act and Regulations (which may be purchased, either directly or through any bookseller, from Messrs. Wyman & Sons Fetter Lane, London, E.C.).

Whitehall Place, London, S.W.,
August, 1911.
Revised, April, 1913.

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* *See* note on page 4.

Leaflet No. 256.

BOARD OF AGRICULTURE AND FISHERIES.

A Disease of Narcissus Bulbs.

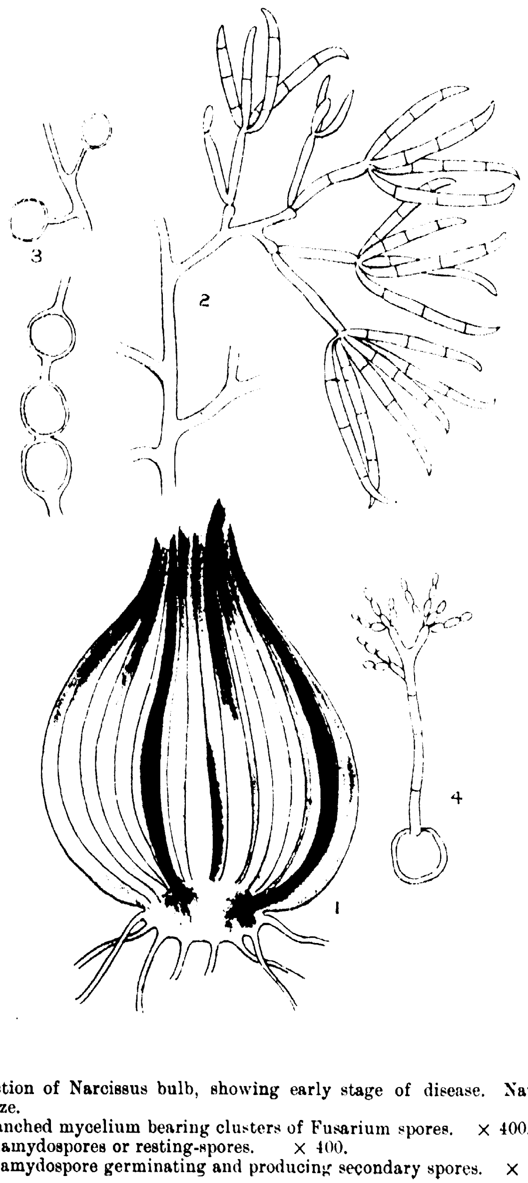
(*Fusarium bulbigenum*, Cooke & Mass.)

About three years ago a disease of an unusual nature was met with on various kinds of Narcissus bulbs. During the season of 1913 the disease increased to such a serious extent that, according to the statement of growers on a large scale, entire plots of bulbs were completely destroyed. The injury was due to the presence of a parasitic fungus called *Fusarium bulbigenum*, Cooke & Mass., first described in 1887, the host being given as a Narcissus bulb. At that time it was not recognised as a parasite.

Description and Methods of Infection.

On the Leaves.—As a rule the presence of the parasite is first indicated by the appearance of small, yellowish spots on the leaves. These spots gradually increase in size, become brown and dry, and more or less covered with pale salmon-coloured specks, which are at first somewhat gelatinous, but which soon become dry and horny when exposed to the air. These coloured patches are masses of Fusarium spores, which are dispersed by various means and infect neighbouring plants. The mycelium present in the leaf can be traced passing downwards into the bulb, where it grows vigorously and spreads rapidly in the fleshy bulb-scales. During the early stage of infection of the bulb, the tips of the scales only are injured, as indicated by the brown colour; the injury, however, gradually extends to the base and enters the "cushion," from whence it spreads rapidly, and very soon the entire bulb is of a uniform brown colour. When this stage is reached, the fungus forms delicate, whitish sheets between the bulb-scales, and numerous chlamydospores or resting-spores are produced on the mycelium present in the substance of the scales. These spores are globose, colourless, with a thick cell-wall, and are produced at the tips of branches, or occur in chains in the length of the mycelium. They vary from 10–14μ in diameter. The Fusarium spores are borne in clusters at the tips of short branches, and in the mass are tinged salmon-colour, but are colourless under the microscope; they are tri-septate, with tips pointed and slightly curved. In size they vary from 40–50 $\times$ 5–6μ.

On the Bulbs.—When a bulb becomes brown, it soon commences to decay, and its complete destruction is hastened



1. Section of Narcissus bulb, showing early stage of disease. Natural size.
2. Branched mycelium bearing clusters of Fusarium spores. × 400.
3. Chlamydospores or resting-spores. × 400.
4. Chlamydospore germinating and producing secondary spores. × 400.

by the attacks of various kinds of saprophytic fungi, *Penicillium*, &c., and by saprophytic eelworms, such as species of *Rhabditis*. When bulbs decay in this manner before lifting, as frequently happens, the soil becomes infected by the liberation of the chlamydospores, which infect future crops. The germinating chlamydospores emit one or two short, slender branches, which bear a few short chains of minute, colourless, elliptical secondary-spores, measuring about $3 \times 2\mu$. These minute spores are the first to infect Narcissus leaves in the spring, after which the disease is continued throughout the season by means of the Fusarium form of spore. It is highly probable that the first infection, by means of the minute secondary-spores produced by the chlamydospores, occurs when the leaves are quite young, and that the disease gradually descends to the base of the leaf and into the bulb, by a series of subsequent infections lower and lower down the leaf, due to independent infections by spores washed from diseased patches higher up the leaf. Chlamydospores are present in abundance in the tissues of the leaves.

In one experiment which was carried out, the young leaves of a Narcissus, about one inch long, were infected with Fusarium spores, and in six days yellowish spots appeared at the points of infection, and as the leaves continued to increase in length, other diseased spots appeared lower down the leaf, mycelium in all instances being present in abundance in the tissues a week after the infection period.

Causes of Distribution, and Remedial Measures.

The continuance of this disease may be due to two independent causes:—

(1) To slightly diseased bulbs, containing the Fusarium spores or chlamydospores. Such bulbs are not readily detected when the injury is slight, but if they are cut in two the presence of disease is readily indicated by the browning of the scales near the neck of the bulb. It is very doubtful whether soaking slightly diseased bulbs in a fungicide would kill the mycelium present; it certainly would not kill thick-walled chlamydospores or resting-spores.

(2) To infected soil. Whenever a crop of diseased bulbs has occurred, it may be concluded with certainty that the soil is infected, owing to the decay of bulbs before lifting, and to fallen diseased leaves, both of which contain chlamydospores in their tissues. So far as is known at present, the fungus has only been met with on Narcissus bulbs, but it may extend its ravages to other bulbous plants. For this reason the safest course would be to avoid planting

bulbs for two or three years on land that had produced a diseased crop. No kind of dressing would be likely to destroy the chlamydospores directly, but during the spring, when they are germinating and producing secondary-spores, the latter would be killed by a dressing of kainit, or of sulphate of potash, lightly worked into the soil.

The disease is known in Holland, from whence it may often be re-introduced into this country by means of slightly infected bulbs.

Whitehall Place, London, S.W.,
June, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The International Agricultural Institute: Its Objects and its Publications.

The International Agricultural Institute owes its inception to the initiative of His Majesty the King of Italy, who early in 1905 invited the different Governments of the world to take part in a Conference, to be held at Rome in the May following, for the purpose of considering the constitution and organisation of the proposed Institute.

This Conference was attended by the representatives of some 40 different States, and in accordance with the agreement then reached the International Agricultural Institute was established as an official institution supported by the various Governments concerned, each of which is represented in the General Assembly of the Institute by delegates of its own selection. Up to the present time 49 different countries, including Great Britain and Ireland, India and most of the self-governing Dominions and Colonies of the British Empire have become affiliated to the Institute.

The Institute is housed in a beautiful building, which, by the munificence of His Majesty the King of Italy, has been erected at Rome in the grounds of the Villa Umberto I. This building contains large rooms for meetings in the central portion, while the wings contain the offices, library, and the rooms occupied by the foreign delegates.

The Objects of the Institute.

The Constitution of the Institute provides that, whilst limiting its action to international questions, it is to be the duty of the Institute :—

(*a.*) To collect, elaborate, and publish, with as little delay as possible, statistical, technical, or economic information regarding the cultivation of the soil, its production, whether animal or vegetable, the trade in agricultural products, and the prices obtained on the various markets.

(*b.*) To send to interested parties, in as rapid a manner as possible, full information of the nature above mentioned.

(c.) To indicate the wages of rural labour.

(d.) To notify all new diseases of plants which may appear in any part of the world, indicating the districts affected, the spread of the disease, and, if possible, efficacious means of resistance.

(e.) To consider questions relating to agricultural co-operation, insurance, and credit, in all their forms, collecting and publishing information which may be useful in the various countries for the organisation of undertakings relating to agricultural co-operation, insurance, and credit.

(f.) To present, if expedient, to the Governments, for their approval, measures for the protection of the common interests of agriculturists and for the improvement of their condition after having previously taken every means of obtaining the necessary information, *e.g.*, resolutions passed by International Congresses or other Congresses relating to agriculture or to sciences applied to agriculture, Agricultural Societies, Academies, Learned Societies, &c.

All questions relating to the economic interests, the legislation and administration of any particular State are to be excluded from the sphere of the Institute.

It will be seen from this that the Institute is in effect an International Agricultural Intelligence Department for the collection, collation and publication of technical, economic and statistical information of interest to agriculturists, special prominence being given to crop reports, prices, plant diseases, co-operation, insurance, and credit.

Publications of the Institute.

The task of organising the Institute on a basis which would enable it to cope with the extensive programme thus laid down presented many difficulties. These difficulties were, however, successfully overcome, and during the past year the labours of the Institute have assumed a practical form in the regular publication of three separate periodicals together with several Reports on special subjects.

These publications, which are of much value to Agriculturists, are described below.

1.—*Monthly Bulletin of Agricultural Statistics.*—This publication, which is issued about the 20th of each month in English and four other languages, furnishes statements as to the area, production and condition of the crops in different countries of the world based on the official information supplied to the Institute. The estimated and actual figures of area and production, and also the condition of the crops, are for purposes of comparison reduced to a common uniform

standard, and expressed in percentages of the average of several preceding years.

2.—*Monthly Bulletin of Economic and Social Intelligence.*—This publication, which usually contains about 250 pages, is issued in French and provisionally in English. It deals with co-operation, insurance, credit and other economic questions relating to agriculture.

3.—*Bulletin of Agricultural Intelligence and Plant Diseases.*—This Bulletin differs to some extent from the foregoing in that it is exclusively composed of summaries of or extracts from reports, newspapers, bulletins and similar publications of a technical character. The summaries are classified according to subject and embrace agricultural chemistry and botany, the cultivation of crops in all parts of the world, live stock and live stock products, agricultural industries and machinery, plant diseases and destructive insects.

Subscription Rates.

In order to enable farmers and others in Great Britain to obtain copies of the above publications with a minimum of trouble, the Board have made arrangements with the Institute for the Board to supply copies direct at the following rates, including postage :—

	Annual Subscription.			Single Copy.	
	s.	*d.*		*s.*	*d.*
Bulletin of Agricultural Statistics ...	4	9	...	0	6
Bulletin of Economic Intelligence ...	14	3	...	1	7
Bulletin of Agricultural Intelligence	14	3	...	1	7
Subscription for the three Bulletins	28	6	...	—	

The sums mentioned should be forwarded to the Secretary Board of Agriculture and Fisheries, Whitehall Place, S.W.

Remittances should be made payable *not to any individual by name* but to "*The Board of Agriculture and Fisheries, or Order*," and crossed "*Bank of England.*"

Other Publications.

In addition the Board have arranged to supply direct copies of certain other publications of the Institute as under :—

	s.	*d.*
Monographs on Agricultural Co-operation in Various Countries, Vol. I.	2	9
Annuaire International de Statistique Agricole, 1910...	4	0
Annuaire International de Legislation Agricole, 1912	7	11

Remittances for the above publications should be forwarded to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, S.W.

The Institute has also issued some other publications, copies of which can be obtained from Rome direct at the price mentioned below, viz. :—

L'organisation des services de statistique agricole dans les divers pays (Tome 1er)	4 francs.
L'organisation des services de statistique en Suède	1 franc.
Statistique des superficies cultivées, de la production végétale et du bétail dans les pays adhérents (Essai d'inventaire d'après les documents publiés par les États)	5 francs.
Bulletin bibliographique hebdomadaire ...	50 centimes per number.
Do. Annual subscription	12 francs.
Catalogue de la Bibliothèque (Année 1909) ...	3 francs.
Liste des revues et journaux régulièrement reçus par l'Institut, 1912	0·50 francs.
L'assurance-grêle dans quelques pays et ses problèmes, 1911	1·50 francs.
L'organisation de la statistique de la coopération agricole dans quelques pays, 1911 ...	1·50 francs.
An Outline of the European Co-operative Credit Systems, 1912	0·50 francs.
L'organisation actuelle du service de protection contre les maladies des plantes et les insectes nuisibles dans les divers pays, 1911	1·50 francs.
L'activité de l'Institut International d'Agriculture dans le domaine de la coopération, de l'assurance et du crédit agricole, 1912 ...	0·50 francs.
Recueil des coefficients pour la conversion des poids, mesures et monnaies au système métrique décimal, 1912	0·50 francs.

. Remittances for these publications should be made directly to the International Institute of Agriculture (Office of the Secretary General), Villa Umberto I., Rome.

Whitehall Place, London, S.W.,
August, 1911.
Revised, February, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 258.

BOARD OF AGRICULTURE AND FISHERIES.

Rural Party Line Telephones.

The Board desire to call the attention of farmers and others to the facilities now offered by the Postmaster-General for the co-operative use of a telephone service, which, from several points of view, should prove of very great value to residents in rural districts.

The Postmaster-General has issued a memorandum on this subject in which it is stated that residents in rural districts are apt to think that a telephone is a luxury of town life which it is impossible to enjoy in the country except at a high cost. This is true if each person requires a separate exchange line, consisting of two wires over the whole distance between the exchange and his residence, to be provided for his exclusive use, but such a line is not necessary in order to enjoy most of the advantages of the telephone service. If a sufficient number of subscribers living on or near a country road leading to a town where there is a telephone exchange will agree to use one line, they can telephone as much as they please to people on that exchange for a moderate fixed charge which ranges from £3 to a little more than £3 10s. according to the number of subscribers per mile.

In the United States there are to-day more telephones in use by farmers than the whole number in use by the commercial and all other classes in the United Kingdom, and these telephones are found to add to the profits and comfort of the farmers to an extent which makes the cost of the telephones seem negligible.

The Postmaster-General is ready to provide lines of the same kind in the rural districts of the United Kingdom. By means of such a line a farmer can speak from his farm to all the people who are telephone subscribers with whom he does business, not only in the nearest town but also as a rule in all places within a distance of about 100 or 150 miles. He can also send messages and receive replies by telephone when his correspondents are not telephone subscribers, or he can get them to speak to him from a public call office. If a machine is broken he can order a new part without the trouble of a journey into the town or the delay of sending an order by post. He can get the latest information as to market prices, and arrange to the best advantage for the sale of his produce and stock, and he can get any weather reports and forecasts which he may want to guide him when crops have to be gathered. In the case of illness a doctor can be summoned, or a veterinary surgeon for his horses and cattle.

If a fire occurs assistance can be called. He can speak to any neighbouring railway station and arrange for the despatch or delivery of his goods and produce. He can despatch a telegram without the trouble of sending a messenger to the telegraph office and he can receive his telegrams by telephone without waiting for a messenger to bring them out, and he can also call a messenger to take an express letter. In a short time the telephone becomes the most valued implement of the farm.

Co-operative movements among farmers for the use of central dairies and creameries, or for the collection and distribution of produce, can only be worked to the best advantage if a telephone service is available to bring the farms of members into direct communication with the central establishments.

If a farmer has a telephone he can in a few minutes, when he is at home for breakfast, dinner, or supper, do business which otherwise would involve inconvenient and expensive journeys to neighbouring towns, or which he could not do at all owing to the delay involved in reaching the other parties concerned. When his work is over, he and his family can talk to their friends and neighbours, and can even arrange social meetings which would otherwise be impossible. In many other ways, too numerous to mention, the telephone helps him to overcome the chief drawbacks of country life and enables him to do business on as good a footing as if he lived in a town.

Those who would like to have a telephone service of this kind in their district, should write to the Secretary, General Post Office, London. They should first, however, try to interest their neighbours in the scheme, and find out how many are willing to join at the rate of £3 per year for unlimited calls on their own exchange, and with the power of talking to other towns at the rate of 1*d.*, 2*d.*, 3*d.*, per conversation, according to the distance for towns within 25 miles and at the rate of 6*d.* for towns within 50 miles.

Particulars of the rental and other charges, and the general conditions relating to rural party lines for the use of farmers and other residents in rural districts are as follows :—

I.—Rate of Subscription.

£3 per annum per telephone, provided that not fewer than three telephones are rented by subscribers on each party-line, and that on an average there are three telephones to each mile of line. With two subscribers per mile the rate is £3 10*s*. a year, and, in exceptional instances, where there are less than two subscribers per mile, lines are provided at a somewhat higher charge. The first half mile from the exchange is not counted in the length of the line.

II.—Particulars of Service.

Exchange Calls.

The subscription covers an *unlimited number of calls* to other subscribers whose telephones are connected with the same exchange.

Calls to Other Exchanges.

Calls to subscribers connected with other exchanges can be made at the following fees :—

Day Service Charge. (7 a.m. to 7 p.m.)	Night Service Charge. (7 p.m. to 7 a.m.)
Up to 25 miles—1*d*., 2*d*., or 3*d*. for 3 minutes...	1*d*., 2*d*., or 3*d*. for 6 minutes.
26 to 50 miles—6*d*. for 3 minutes	6*d*. for 6 minutes.
51 to 75 miles—9*d*. " "	6*d*. " 3 " 9*d*. " 6 "
76 to 100 miles—1*s*. " "	6*d*. " 3 "
Every additional 40 miles or part thereof—6*d*. for 3 minutes	3*d*. " 3 "

Other Conditions.

(*a*.) It is essential that a *sufficient number of subscribers* whose residences lie in the same direction from the exchange should be willing to share a party-line.

(*b*.) Subscribers can co-operate to keep the working of the system thoroughly effective by replacing their receivers as soon as, on entering the circuit, they hear that another conversation is going on and by not prolonging conversations unnecessarily at a time when other subscribers may want to make use of the facilities.

(*c*.) It is essential that subscribers should assist the Post Office by granting any wayleaves on their property that may be necessary.

Further information on the subject of Rural Party-Lines can be obtained from The Secretary, General Post Office, E.C.

Whitehall Place, London, S.W.,
September, 1911.
Revised May, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 259.

BOARD OF AGRICULTURE AND FISHERIES.

Swift Moths (*Hepialidae*).

The *Hepialidae* are an isolated family of moths showing some primitive characters. There are five British species. Three of these feed—in the caterpillar stage—on and in the roots and rhizomes of the bracken fern (*Pteris aquilina*). The two troublesome species are the Small Garden Swift Moth (*Hepialus lupulinus*, L.) and the Ghost Swift Moth (*Hepialus humuli*, L.). The caterpillars feed underground.

The Small Garden Swift Moth.

The caterpillars of *Hepialus lupulinus* are very destructive; their food plants belong to many Natural Orders. In the past three years the caterpillars have been reported to the Board as damaging—often severely—the underground parts of daffodils (the bulbs especially), peonies, dahlias, chrysanthemums, and lily-of-the-valley. In the literature dealing with this moth there is a long list of host-plants:—grasses, oats, snowdrop, colchicum, gladiolus, lily, peas, beans, strawberries, raspberries, parsnip, celery, parsley, potatoes, horehound, white and purple dead nettles, phlox, *Chelone barbata*, lettuce, auriculas, and dock.

Hepialus lupulinus is common over England and Wales, but not so common in Scotland, although it has been taken as far north as the Orkneys; it is also found in Ireland.

Description.—Moth: The moth (Fig. 1) varies in colour and in size. In spread of wing the measurement is from 1 inch to 1½ inches. In the male the thorax and abdomen are yellow-brown. The front wings are brown—sometimes lighter, sometimes darker—with a white stripe that runs from the middle of the base of the wing, and parallel for a short distance with the hind edge of the wing, when it then suddenly bends and runs obliquely across the wing to near the apex. About the middle of each fore-wing is a white spot or dash. The hind-wings are purple-brown or smoke-coloured, with pale brown fringes. The female moth is of the same general colour as the male; the markings, however, are not so distinct, and the white stripe may be absent. Antennæ and legs are short in both sexes.

Larva: The caterpillar has sixteen legs, and, when full grown, measures an inch and over according to its extension. It is whitish or yellowish-white in colour; the head is brown, as is also the plate or shield on the upper surface of the joint behind the head. The other segments of the body show dark

or light dots on their upper surface, and each dot carries a stiff black hair; the spiracles are black.

Pupa: The pupa is shining red or pale brown, with the head and wing cases darker. The segments of the abdomen are markedly divided off from one another; five of them have horny ridges with projecting teeth on their upper surface, and four of them have similar spines on the under surface. The pupa is enclosed in a delicate cocoon; within this cocoon the pupa, on being touched, wriggles violently. Before the adult moth issues the pupa presses itself out of the cocoon and above the surface of the soil so as to allow of emergence of the moth.

Life History.—The moths emerge in May and June, but stragglers may be found later. They appear about dusk. The male is a very active flier; the female is more restful, hanging to some grass or other stem, and attracting the male by a rapid vibration of her wings. After pairing, the female flies among herbage and drops her eggs as she flies. The caterpillars live underground, and feed from late June on through July and to the next April or May, *i.e.*, they remain in the caterpillar stage all the winter, feeding more or less continuously in open winters, and going a little deeper, during frost, for protection. Pupation of the full-fed caterpillar takes place at the end of April, in May, and in June.

The Ghost Swift Moth.

The caterpillars of *Hepialus humuli* are also troublesome enemies. A correspondent of the Board who sent one of the caterpillars taken from a carrot tunnelled by it, wrote that the caterpillars had been very destructive to this crop, and that frequently he dug them up with the spade whilst digging a new plot. Curtis in 1848 recorded a similar attack on a carrot, the caterpillar being found in "a cavity 2 or 3 inches long." Theobald and others have recorded this caterpillar as destructive to the roots of hops; on the Continent it is a proved enemy of hops, tunnelling in the roots. Carpenter has recorded the caterpillar as attacking potatoes and the roots of oats in Roscommon. Barrett gives as food-plants dandelion, dead-nettle, Jerusalem artichoke, and asparagus. It feeds also at the roots of burdock, nettle, and dock.

The Ghost Moth is common in Britain from north to south, and in Ireland.

Description.—Moth: The moth (Fig. 2) measures from 1½ to 2¾ inches in spread of wings. There is a marked colour difference between the male and the female. All the four wings of the male are usually silvery-white, but the hind wings may be greyish. The fore-wings of the female are broader and are yellow, with orange or brown-red markings;

the hind wings of the female are greyish, and tinged with red at the apex. The female varies somewhat in colour, and there is in the Shetland Isles a variety in which the colour of the male approaches that of the female.

Egg: The eggs are small and round. Barrett describes them as greenish when first laid, but becoming black.

Larva: The caterpillar measures 1½ inches when full grown; in colour it is whitish or pinkish-white, with the spiracles black. The head is red-brown, as is also the dorsal

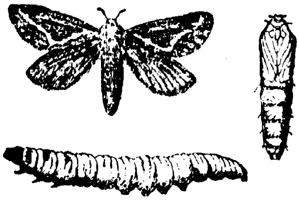


FIG. 1.—SMALL GARDEN SWIFT MOTH (*Hepialus lupulinus*). (Natural size.)

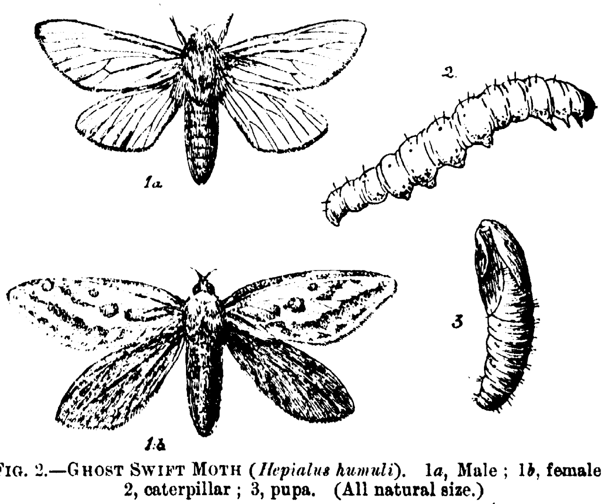


FIG. 2.—GHOST SWIFT MOTH (*Hepialus humuli*). 1*a*, Male; 1*b*, female 2, caterpillar; 3, pupa. (All natural size.)

plate on the joint behind the head; there are black or dark-brown dots on the upper surface of the segments of the body, with black hairs.

Pupa: The colour of the pupa is dark chestnut; the upper surface of the abdominal joints shows a number of dark brown points, and there are black teeth on the under surface; the last segment has marked black points. The pupa is enclosed in a slight cocoon, and lies in the soil quite near the surface.

Life History.—The moths fly in June and July. The courtship of this species has been described by Chapman. The moths fly in the gloaming. The male, ghost-like and conspicuous by the silvery white colour in spite of the dusk, chooses a place and hovers for a short time backwards and forwards, "swaying like a pendulum over a surface of about a yard" (Barrett) in order to attract the female. Sometimes the male is alone, sometimes there are several males in company. The female, non-fertilised, flies towards a male and intentionally touches or knocks up against the male, which at once ceases its swaying and drops to the ground, where pairing takes place. The fertilised female flies about over the grass, discharging her eggs as she flies. From the egg hatches the caterpillar, which feeds from July till the next April or May at least, when pupation takes place. As with the last species, the pupa leaves the cocoon just before the emergence of the moth, and by means of its spines wriggles to the surface.

Treatment.

1.—Vaporite has been used with some success against swift caterpillars, while in a confined area where the caterpillars are at work the use of bisulphide of carbon injected into the soil would destroy them.

2.—Pieces of potato tuber placed here and there some inches below the surface of the soil, in marked places, will serve as traps.

3.—The working of the soil where the crop allows, and the turning up of the caterpillars (or in spring the chrysalids) to the birds is a useful measure, or the caterpillars can be collected.

4.—In some cases, e.g., with daffodils, should the pest be abundant, the bulbs should be lifted and replanted.

5.—Birds and moles devour the caterpillars, which are also destroyed by two species of parasitic fungi, viz. *Cordyceps militaris* and *C. entomorrhiza*.

Whitehall Place, London, S.W.,
October, 1911.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 260.

BOARD OF AGRICULTURE AND FISHERIES.

Statistics of Agricultural Co-operative Credit Societies in England and Wales.

This leaflet deals only with Co-operative Societies which confine their operations to the granting of loans to small agriculturists; it takes no account of societies which grant loans to urban residents, or of societies which may make cash advances to members in addition to their main business of agricultural production, distribution or supply.

It is possible to form an Agricultural Co-operative Credit Society under the Industrial and Provident Societies Act, with shares and share-capital and limited liability, but, as a matter of fact, all the societies of this character now in existence in England and Wales have been registered under the Friendly Societies Act, 1896, and the Special Authority granted by the Treasury in accordance with Section 8 (5) of the Act. A society registered under that Authority must have for its object the creation of funds by monthly or other subscriptions, to be lent out to, or invested for, the members of the society, or for their benefit, and must have in its rules provisions that no part of its funds shall be divided by way of profit, bonus, dividend, or otherwise among its members, and that all money lent to members shall be applied to such purpose as the society or its committee of management may approve.

There is nothing in the Friendly Societies Act to prevent the registration of a society in which the liability of the members for the debts of the society is limited to a fixed sum in each case (or limited by guarantee, as it is called); but no society has yet been formed on this basis, and all the existing societies have adopted a rule to the following effect:—

"Every member of the Society shall be, equally with every other member, jointly and severally liable for all debts incurred by the Society, and for any loan which a member or his sureties may fail to pay."

Thus in all the existing societies the liability of each and all of the members for debts due by the society is unlimited,

and the ultimate security offered by the society for advances made to it is the total property of all its members put together.

A society registered under the Friendly Societies Act has to submit its rules to the Chief Registrar, whose duty it is to satisfy himself that they are not contrary to the Act. Most of these societies have adopted the model rules recommended by the Agricultural Organisation Society, to which all but two of them are affiliated, and the others have rules which are in all important respects similar; so that regarding all of them it may be said that, besides the principle of unlimited liability, they have the following features in common.

No one can be admitted as a member unless he lives within a certain circumscribed area, such as a parish, or two or more adjoining parishes, and so is personally known to most of his fellow-members. He must also be approved by the committee as a man of good character, worthy of admission to the society. All the members have an equal voice in the election of the committee and the management of the society.

Loans to members are granted only on approved security, and must be utilised only for a specific purpose, which, in the opinion of the committee, is such that there is a sufficient prospect of the loan repaying itself by the production, business, or economy which it will enable the borrower to effect. No member can have out on loan more than £50 altogether at any time, but he can repay one loan and afterwards take out another, not exceeding £50.

The society may receive deposits, either from members or non-members, and may pay interest on them.

No profit may be divided among the members of the society. All profits must be carried to a reserve fund, which can only be drawn upon to meet exceptional losses by resolution of the general meeting of the society. Even if the society is dissolved, this reserve fund cannot be divided among the members, but must be spent on some useful purpose in the parish. Thus the only pecuniary benefit a man may expect to gain by becoming a member of such a society is that of obtaining loans for profitable purposes connected with agriculture at a low rate of interest; and if he is unlikely himself ever to require such a loan, his motive for joining as member can only be to help on a beneficial movement, and to assist his neighbours, by his guarantee and guidance, to get small loans on advantageous terms.

The accounts of the society, with the exception of those relating to individual loans and deposits, are open to the inspection of all interested in the funds. They must be audited annually and submitted to the Chief Registrar, and a copy of the annual balance sheet must be conspicuously displayed for the information of all concerned.

At the end of 1910 there were in England and Wales 40 registered societies of the above type, scattered over twenty counties. Six of these were registered in 1895 and 1896, seven were registered in the three years 1904 to 1907, and in the three years 1908, 1909 and 1910 the numbers registered have been respectively seven, ten, and ten, so that the movement has recently shown signs of more rapid development.

Of these 40 societies, nine either sent in no returns or reported that they had as yet done no business. According to the annual returns for the year 1910, submitted to the Chief Registrar by the remaining 31 societies, they had at the end of the year 663 members—an average of 21 per society. They had during the year advanced 119 loans to their members, so that less than one in five of the members took out a loan during the year. The loans aggregated £1,390, and averaged £12 per loan; in individual cases they varied from £3 to £40. The earnings of these 31 societies during the year amounted to £147 (including a gift of £50), and the charges of the year were £82, so that there was a net profit on the year's working of £15, besides the gift. Their expenses of management, which are included in the above charges, amounted to £34, or a little over £1 per society. Their total assets amounted to £1,924, of which £1,421 were out on loans to members, and their total liabilities to £1,654, of which £489 were due to banks and £1,088 to depositors; and the total profits to date of all the 31 societies put together amounted to £270. This total includes gifts aggregating £115, so that the profits actually earned to date were £155, an average of £5 per society.

It takes some years for a credit society to get into working order, and the progress made can be better judged by taking separately the totals for the six oldest societies, which have been at work for over fourteen years. Between them they had in 1910 145 members (an average of 24 per society), and during the year they gave out 34 loans, so that about one in four of the members took a loan. The loans aggregated £511, and averaged £15 per loan. The rate of interest charged on loans to members was, in four societies, 5 per cent., in one 6 per cent., and in one only 4 per cent. They had secured deposits amounting to £481, paying interest on them at 3 per cent. in four societies, and at 4 per cent. in one. Two of them had obtained advances from banks at 4 per cent., and one at 3 per cent. During the year they earned

£36 in interest, and received other income amounting to £1, while their interest charge was only £20, and their expenses of management £6, an average of £1 per society; so that the net profit of the year was £11, or nearly £2 per society. Their assets amounted together to £743, including gifts of £65, and £556 out on loans to members; and their liabilities were £538, including the £481 held on deposit. Their surplus of assets over liabilities amounted to £205 (including the £65 received as gifts), so that they have now, after fourteen years of careful management, built up a reserve fund equal to more than one-third of what their members require in loans during the year. This is their own property, on which they have no interest to pay. The loans have been repaid punctually, and the societies have made no bad debts and incurred no losses, and only in three or four cases have they had to call on the sureties to help in repaying loans due from members. In hardly any case has the surety ultimately failed to recover the money from the actual borrower.

The loans were all taken out for purposes likely, in the opinion of the committee, to prove profitable, such as the purchase of sheep, pigs, cattle, horses, carts, implements, seed, manure, or cattle feed, or the employment of extra labour on the borrower's holding. The loans are generally made repayable about the time when the borrower may expect to reap the return on his expenditure, and the date for repayment is therefore generally from six to twelve months after the date of the loan; some loans, however, were granted for two years, repayable by six-monthly or annual instalments.

The members agree in saying that they have derived great benefits from the existence of these societies, which have enabled many of them to obtain the small loans needed for their agricultural operations at a lower rate of interest than they would have had to pay elsewhere, and some of them to obtain loans who could not otherwise have borrowed at all. They cite instances of men who were enabled, by a loan from the society, to buy and feed sheep, pigs, or cattle, to hold over stock for better prices, to procure seed, plants, or manure, to work their land to better advantage, or to add to the area of their holdings, and of some who, by means of a succession of such loans, have risen from the position of labourers to that of substantial small-holders.

The establishment of these societies in the rural villages in which they are found has evidently not only added to the prosperity of many of the villagers, but has stimulated neighbourly feeling by showing men how they can help their fellows by the exercise of care and mutual trust, without any real pecuniary risk to themselves, has encouraged

thrift and efficient methods of cultivation, and has at the same time increased the self-respect of the individual members, and inspired them with hopes of progress.

Appended are a general statement of the Societies for the year ending 31st December, 1910, and a Balance Sheet as at the same date.

(See also Leaflet No. 214, *Agricultural Credit Banks.*)

Whitehall Place, London, S.W.,
January, 1912.

AGRICULTURAL CO-OPERATIVE CREDIT SOCIETIES IN ENGLAND AND WALES.

General Statement for the Year ending 31st December, 1910.

Serial Number.	County.	Name of Society.	Year of Registration.	No. of Members at end of year.	Loans granted during the year. No.	Loans granted during the year. Amount. £	Rate of Interest received by the Society on Loans to Members.	Rate of Interest paid by the Society on Deposits.
1	Lincoln ...	Scawby	1895	32	6	175	5	3
2	Suffolk ...	Laxfield	1895	6	—	—	5	3
3	Warwick ..	Grandborough ...	1895	7	—	—	—	—
4	Worcester.	Castle Morton ...	1896	21	2	15	6	3
5	Hampshire	Hedge End	1896	34	17	194	4	3
6	Norfolk ...	Wiggenhall... ...	1896	45	9	127	5	4
		Total for six societies ...		145	34	511		
7	Lincoln ...	Friskney	1904	32	4	56	5	3
8	" ...	Spalding	1904	76	—	—	5	4
9	Worcester.	Far Forest	1904	7	—	—	6	4
10	Bedford ...	Clophill	1905	16	6	22	—	—
11	Norfolk ...	Whissonsett... ...	1905	24	9	69	5	3
12	Hertford ..	Barley	1907	13	—	—	6	—
13	Leicester...	Brookvale	1907	42	14	101	5	3
		Total for seven societies...		210	33	248		
14	Surrey ...	Dormansland ...	1908	24	—	—	—	—
15	Bucks ...	High Wycombe ...	1908	13	7	72	6	—
16	Leicester ..	Mountsorrel ...	1908	27	3	121	5	$2\frac{1}{2}$
17	Kent ...	Bromley	1908	22	1	15	—	—
18	Hereford ..	Froomeshill... ...	1908	13	—	—	—	—
19	Cambridge	Coates	1908	—	—	—	—	—
20	Middlesex	"All for Each," Southall.	1908	9	—	—	6	3
21	Essex ...	Coggeshall	1909	20	4	49	5	—
22	" ...	Tiptree	1909	26	12	168	5	—
23	Glamorgan	St. Fagan's	1909	13	—	—	—	—
24	Surrey ...	Limpsfield	1909	21	2	7	5	—
25	" ...	Croydon	1909	24	—	—	5	3
26	Norfolk ...	Trunch	1909	—	—	—	—	—
27	" ...	Stiffkey	1909	—	—	—	—	—
28	Glamorgan	Cadoxton	1909	11	—	—	—	—
29	Bucks ...	Drayton Parslow ...	1909	22	10	101	6	3
30	Lincoln ...	Gedney Dyke ...	1909	—	—	—	—	—
31	Leicester ..	Oadby	1910	19	8	50	—	—
32	Norfolk ...	Wayford	1910	—	—	—	—	—
33	Kent ...	Halstead	1910	13	3	40	5	—
34	Glamorgan	Barry	1910	11	—	—	—	—
35	Kent ...	High Halstow ...	1910	—	—	—	—	—
36	Oxford ...	Islip	1910	14	1	5	6	—
37	Surrey ...	Epsom	1910	—	—	—	—	—
38	Worcester.	Cradley	1910	6	1	3	—	—
39	Oxford ...	Heyford	1910	—	—	—	—	—
40	Notts ...	Mansfield Woodhouse	1910	—	—	—	—	—
		Total for eighteen societies		308	52	631		
		Total for thirty-one societies reporting.		663	119	1,390		

BALANCE SHEET AS AT

Serial No.	Name of Society.	ASSETS. Cash in Hand and at Bank. £ s. d.	Investments. £ s. d.	Loans due from Members (Principal). £ s. d.	Interest Accrued but not Received. £ s. d.	Other Assets. £ s. d.	Total Assets. £ s. d.
1	Scawby ...	17 14 10	82 10 0	150 0 0	5 2 1	—	255 6 11
2	Laxfield ...	12 18 7	—	40 0 0	—	—	52 18 7
3	Grandborough	4 2 8	—	79 14 0	—	—	83 16 8
4	Castle Morton	47 9 2	2 10 0	6 10 0	—	—	56 9 2
5	Hedge End ...	9 19 3	—	173 0 0	1 16 2	—	184 15 5
6	Wiggenhall...	0 6 0	0 1 0	107 0 0	2 14 6	—	110 1 6
	Total for 6 Societies.	92 10 6	85 1 0	556 4 0	9 12 9	—	743 8 3
7	Friskney ...	0 5 0	2 10 0	133 0 0	—	—	135 15 0
8	Spalding ...	147 19 6	—	3 0 0	—	—	150 19 6
9	Far Forest ...	0 10 3	—	0 3 0	—	0 5 0	0 18 3
10	Clophill ...	0 19 4	—	—	—	—	0 19 4
11	Whissonsett...	3 10 3	—	71 10 0	—	—	75 0 3
12	Barley ...	0 7 9	2 10 0	—	—	—	2 17 9
13	Brookvale ...	8 9 6½	2 10 0	148 9 3	—	2 5 0	161 13 9½
	Total for 7 Societies.	162 1 7½	7 10 0	356 2 3	—	2 10 0	528 3 10½
14	Dormansland.	0 6 11	—	—	—	—	0 6 11
15	High Wycombe	—	—	70 15 0	0 13 1	—	71 8 1
16	Mountsorrel ..	27 16 5	—	100 15 0	—	—	128 11 5
17	Bromley ...	1 19 3½	2 10 0	13 0 0	—	0 13 0	18 2 3½
18	Froome's Hill	—	0 5 0	—	—	—	0 5 0
19	Coates ...	—	—	—	—	—	—
20	All for Each, Southall.	0 7 10	—	—	—	—	0 7 10
21	Coggeshall ...	81 11 5	—	20 0 0	—	—	101 11 5
22	Tiptree ...	—	—	99 13 4	1 4 6	2 4 7	103 2 5
23	St. Fagan's ...	6 1 8	—	—	—	—	6 1 8
24	Limpsfield ...	4 8 11	—	5 10 0	—	—	9 18 11
25	Croydon ...	0 2 4½	—	—	—	—	0 2 4½
26	Trunch ...	—	—	—	—	—	—
27	Stiffkey ...	—	—	—	—	—	—
28	Cadoxton ...	2 7 6	—	—	—	—	2 7 6
29	Drayton Parslow.	—	2 10 0	101 10 0	0 18 0	—	104 18 0
30	Gedney Dyke	—	—	—	—	—	—
31	Oadby ...	—	2 10 0	50 0 0	—	—	52 10 0
32	Wayford ...	—	—	—	—	—	—
33	Halstead ...	0 2 4	—	40 0 0	—	—	40 2 4
34	Barry ...	1 1 6	—	—	—	—	1 1 6
35	High Halstow	—	—	—	—	—	—
36	Islip	0 8 6	—	5 0 0	—	2 10 0	7 18 6
37	Epsom ...	—	—	—	—	—	—
38	Cradley ...	0 7 2	—	3 0 0	—	—	3 7 2
39	Heyford ...	—	—	—	—	—	—
40	Mansfield Woodhouse.	—	—	—	—	—	—
	Total for 18 Societies.	127 1 10	7 15 0	509 3 4	2 15 7	5 7 7	652 3 4
	Total for 31 Societies reporting.	381 13 11½	100 6 0	1,421 9 7	12 8 4	7 17 7	1,923 15 5½

LIABILITIES.						
Due to Banks.	Due to other Non-members (Principal).	Due to Members on Deposits (Principal).	Interest Accrued but not Paid.	Other Liabilities.	Total Liabilities.	Balance being Total Profit or Loss to date (including Reserve Fund). Loss bears minus sign (–).
£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
—	101 0 0	85 0 0	4 10 6	—	190 10 6	64 16 5
—	40 0 0	—	—	—	40 0 0	12 18 7
—	79 9 6	—	—	—	79 9 6	4 7 2
44 0 0	7 10 0	—	—	—	51 10 0	4 19 2
—	40 0 0	105 0 0	—	—	145 0 0	39 15 5
—	—	23 2 2	0 15 0	8 1 11	31 19 1	78 2 5
44 0 0	267 19 6	213 2 2	5 5 6	8 1 11	538 9 1	204 19 2
—	127 0 0	—	—	1 17 3	128 17 3	6 17 9
—	—	150 12 5	—	—	150 12 5	0 7 1
—	—	—	—	—	—	0 18 3
—	—	—	—	—	—	0 19 4
—	—	72 0 3	—	—	72 0 3	3 0 0
—	2 10 0	—	—	—	2 10 0	0 7 9
151 0 0	0 16 6	—	6 15 2	—	158 11 8	3 2 1½
151 0 0	130 6 6	222 12 8	6 15 2	1 17 3	512 11 7	15 12 3½
—	0 15 0	—	—	—	0 15 0	—0 8 1
70 0 0	—	—	0 9 0	1 12 5	72 1 5	—0 13 4
—	127 0 0	—	—	—	127 0 0	1 11 5
15 0 0	2 10 0	—	—	2 0 0	19 10 0	—1 7 8½
—	—	—	—	0 8 0	0 8 0	—0 3 0
—	—	—	—	—	—	—
—	—	0 3 0	—	—	0 3 0	0 4 10
—	—	100 0 0	—	—	100 0 0	1 11 5
54 3 2	—	—	—	—	54 3 2	48 19 3
—	—	4 19 0	—	—	4 19 0	1 2 8
—	10 0 0	—	—	—	10 0 0	—0 1 1
—	—	—	—	3 9 0	3 9 0	—3 6 7½
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	2 6 0	—	—	2 6 0	0 1 6
100 0 0	—	—	—	3 11 11	103 11 11	1 6 1
—	—	—	—	—	—	—
50 0 0	—	—	—	2 13 6	52 13 6	—0 3 6
—	—	—	—	—	—	—
—	—	—	—	40 0 0	40 0 0	0 2 4
—	1 1 0	—	—	—	1 1 0	0 0 6
—	—	—	—	—	—	—
5 0 0	—	2 10 0	—	—	7 10 0	0 8 6
—	—	—	—	—	—	—
—	—	3 1 2	—	—	3 1 2	0 6 0
—	—	—	—	—	—	—
—	—	—	—	—	—	—
294 3 2	141 6 0	112 19 2	0 9 0	53 14 10	602 12 2	55 14 6 —6 3 4
489 3 2	539 12 0	548 14 0	12 9 8	63 14 0	1.653 12 10	276 5 11½ —6 3 4

Leaflet No. 261.

BOARD OF AGRICULTURE AND FISHERIES.

The Scawby Agricultural Credit Society.

AN EXAMPLE OF AN AGRICULTURAL CREDIT SOCIETY.

Of the 45 Agricultural Co-operative Credit Societies now in existence in England and Wales, the Scawby Credit Society is the oldest. It may therefore justly claim to be the pioneer in this country of the movement for enabling small agriculturists, by combining their credit, to obtain small loans for agricultural purposes on easy terms; and as it has satisfactorily achieved its object, and has now attained a sound financial position, an examination of its history may not be without profit to younger Credit Societies, or to agriculturists who feel the need of some such means of obtaining credit on more favourable conditions than are at present available.

Scawby is a rural parish in Lincolnshire, about two miles from the market town of Brigg. It has a population of about 1,000, and an acreage under crops and grass of 2,825 acres, of which two-thirds are under crops, and one-third under grass. The land is held in 39 holdings, of which 26 are under 50 acres each. A number of the small-holders have other occupations besides agriculture. There is no other local industry, and the parish is typical of many other country parishes in England.

Formation of the Society.

On July 3rd, 1894, after a public meeting had been held under the chairmanship of the principal landowner in the parish, and had been addressed by the Secretary of the Agricultural Banks Association, it was resolved to form an Agricultural Credit Society for the parish of Scawby. Further meetings were held to discuss the proposed rules, and the Society was finally registered under the Friendly Societies Act on November 1st, 1895. The rules provide that the object of the Society is to create funds to be lent out to its members, and that every loan must, in the opinion of the Society, hold

out a sufficient prospect of repaying itself by the production, business, or economy which it will enable the borrower to effect. No part of the funds can be divided by way of profit, bonus, dividend, or otherwise among the members; any surplus accruing to the Society after payment of the costs of management must be carried to a Reserve Fund, which can be drawn upon only to meet exceptional losses by vote of the General Meeting of the members. Only persons (male or female) owning or occupying land or residing in the parish of Scawby or its immediate neighbourhood can be members, and each applicant must be approved by the Committee. Each member has only one vote, and all the members are liable to an equal levy, should funds be required to make up any deficiency in the working of the Society—that is, all the members are equally, jointly, and severally liable for any debts incurred by the Society and no limit has been fixed for their liability. There are no shares and no share-capital.

The Society started with nine members, but by the end of 1895 there were 20. The number of members has since risen gradually until at the end of 1911 there were 32, of whom eleven were small farmers, three market gardeners, three blacksmiths, and two carpenters, besides a butcher, a horse-dealer, a carter, a woodman, a miner, a foreman, and two labourers, most of whom, in addition to their main occupations, cultivate small holdings or allotments. The affairs of the Society are managed by the Chairman and a Committee of six, annually elected by ballot at the general meeting. They at present consist of three small farmers, a carpenter, a blacksmith, and a woodman. The rate-collector of the parish has from the first, as Secretary and Treasurer, kept the accounts and minutes without any salary.

One of the first requisites for the working of the Society was the raising of money to be lent to the members. An account was opened with the local branch of a Joint Stock Bank, to which the Chairman, both on his own behalf and as representing the Society, gave a guarantee limited to £100 for any sums that might be due to the Bank by the Society. Under this guarantee the Society obtained funds from the Bank, and at one time its over-draft amounted to £94, but for the last three years, owing to the growth of deposits, it has not required to over-draw its account at the Bank, and has generally had a balance to its credit. The Bank charged 5 per cent. on overdrafts, and allows 2 per cent. on current account credit balances.

The Society also offered to take deposits at 3 per cent. interest, and at the end of the first year had obtained in this way £39, but by the end of 1911 it had so gained the confidence of the villagers that the amount on deposit with the

Society at 3 per cent. had mounted up to £187, including a considerable sum deposited by the village Dividend Society, formed of working people. Deposits must be left with the Society for a period of not less than three months, and one month's notice must be given of withdrawal, but the Society is at present in a position, with the aid of the Central Bank, to meet ordinary demands for withdrawal within a few days. It retains the right to return any surplus of deposits it does not require, on giving one month's notice to the depositor.

The Object of the Society.

The main object of the Society is to make loans to its members for profitable purposes at a low rate of interest. The first loan granted was one of £30 to a small-holder to enable him to buy lambs to consume feed, the full profit of which he would not otherwise have obtained, and was made repayable in 8 months. In the first year only two loans were granted, in the next one, and in the third two, but the number of loans gradually increased, and in 1910 six loans were made, aggregating £175. During the last 17 years the Society has made to its members 80 loans, aggregating £2,314, and averaging nearly £30, the smallest loan being £5, and the largest £50, which is the maximum loan allowed by the Act. At first the Society charged 5 per cent. per annum interest on loans, but it soon raised this rate to 6 per cent. in order to build up a reserve fund. When that object had been attained, it four years ago reduced the rate to 5 per cent., at which rate its members can now obtain from the Society the capital they require for their agricultural operations.

Loans to members must be expended on some specific purpose, approved by the Committee as likely to be profitable to the borrowing member. The purposes for which loans have been granted have been, for example, to enable the borrower to buy cows, sheep, lambs, pigs, or seed, or to hold over stock or corn for better prices. Loans are generally made repayable at the time when the profits of the transaction are likely to come in to the borrower and for periods varying from three months up to two years. The longer term loans are usually made repayable by instalments. In order to secure the Society against loss, the Committee require the borrower to give security approved by them for the punctual repayment of the loan, generally in the form of two sureties, who may or may not be members of the Society. The Committee carefully watch the utilisation of the loan on the object for which it was granted, and insist on punctual repayment, though they give the borrower time on good cause shown. On three occasions they have had to call on the sureties to make good part of the loan, but the Society

PROGRESS OF SCAWBY CREDIT SOCIETY.

I.

Year.	Number of Members at end of Year.	Loans Granted during the Year.		Rate of Interest Charged on Loans.	Deposits Received during the Year. Amount.	Rate of Interest paid on Deposits.	Expenses of Management.	Profit or Loss on the Working of the Year.		Remarks.
		Number.	Amount.					Profit.	Loss.	
			£		£		£ s. d.	£ s. d.	£ s. d.	
1895	20	2	50	5	39 (includes £5 special loan.)	3	1 0 0	—	0 18 7*	* Paid Registration Fee, £1.
1896	20	1	40	6	12	3	0 0 5	0 10 0	—	
1897	22	2	40	6	15	3	0 0 6	1 0 8	—	
1898	25	4	110	6	20	3	0 0 6	0 19 7	—	
1899	26	4	90	6	—	3	0 1 1	1 12 4	—	
1900	25	5	107	6	50	3	0 16 4†	0 8 0	—	† Paid Registrar, 10s.
1901	27	7	220	6	75	3	0 10 8	3 11 9	—	
1902	28	5	145	6	10	3	0 8 8	3 16 8	—	
1903	29	6	170	5	10	3	0 7 1	4 0 1	—	
1904	29	8	270	6	50	3	0 11 0	5 2 6	—	
1905	28	5	180	6	15	3	0 11 0	6 1 11	—	
1906	28	5	145	6	—	3	0 9 6	4 13 5	—	
1907	27	6	100	6	—	3	0 18 6	3 14 6	—	
1908	28	6	200	5	71	3	0 18 10	4 2 6	—	
1909	29	4	147	5	25	3	0 12 2	5 8 8	—	
1910	32	6	175	5	50	3	0 12 0	5 6 5	—	
1911	32	4	125	5	—	3	0 10 6	4 17 11	—	

II.

Year.	Assets at end of Year.				Liabilities at end of Year.				Total Profit or Loss to date at end of Year.	
	Cash.	Loans Due from Members.	Other Assets.	Total Assets.	Due to Banks.	Due to Depositors.	Other Liabilities.	Total Liabilities.	Profit.	Loss.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	—	50 12 4	1 12 4	52 4 8	11 7 9	39 4 6	2 11 0	53 3 3	—	0 18 7
1896	—	41 0 6	1 11 8	42 12 2	8 16 0	31 4 9	3 0 0	43 0 9	—	0 8 7
1897	0 0 3	41 7 0	0 1 10	41 9 1	6 11 6	34 5 6	—	40 17 0	0 12 1	—
1898	0 17 8	101 16 0	0 1 5	102 15 1	60 15 6	40 7 11	—	101 3 5	1 11 8	—
1899	—	50 8 9	0 1 0	50 9 9	31 18 1	15 7 8	—	47 5 9	3 4 0	—
1900	—	103 8 7	0 0 7	103 9 2	34 10 11	65 4 3	0 2 0	99 17 2	3 12 0	—
1901	—	194 13 9	—	194 13 9	69 4 3	102 11 9	0 8 0	172 4 0	22 9 9	—
1902	—	148 15 5	—	148 15 5	61 16 1	60 3 6	0 9 5	122 9 0	26 6 5	—
1903	—	138 3 0	—	138 3 0	37 16 6	70 0 0	—	107 16 6	30 6 6	—
1904	—	219 13 0	—	219 13 0	94 4 0	90 0 0	—	184 4 0	35 9 0	—
1905	—	200 11 0	—	200 11 0	54 0 1	105 0 0	—	159 0 1	41 10 11	—
1906	—	137 7 0	—	137 7 0	36 2 8	55 0 0	—	91 2 8	46 4 4	—
1907	—	104 14 0	2 10 0	107 4 0	2 5 2	55 0 0	—	57 5 2	49 18 10	—
1908	—	192 2 2	7 10 0	199 12 2	33 12 10	111 18 0	—	145 10 10	54 1 4	—
1909	6 19 11	183 6 7	7 10 0	197 16 6	—	138 6 6	—	138 6 6	59 10 0	—
1910	17 14 10	152 18 10	84 13 3	255 16 11	—	190 10 6	—	190 10 6	64 16 5	—
1911	16 6 2	153 2 6	87 2 6	256 11 2	—	186 16 10	—	186 16 10	69 14 4	—

tself has made no bad debts, and has incurred no loss. It is believed that the sureties ultimately recovered the amounts they had paid. No repayments of loans were overdue at the end of 1911. Several of the members say the existence of the Society has enabled them to undertake profitable transactions with sums borrowed from the society, which they could not have obtained elsewhere, and one family at least has, by its own thrift and industry, and with the help of successive loans from the Society, risen from the position of day-labourers to that of substantial small farmers.

One borrower repaid his loan three months before it was due, cheerfully paying interest for the full term for which it was borrowed, as he said that the loan had benefited him greatly, and he wished in return to benefit the Society. Another man, who had borrowed £5 to enable him to hold over his fat pig for a better price, also repaid his loan before it was due, with interest in full, saying he considered the transaction had left him ten shillings to the good.

As the whole work of the society has hitherto been done for nothing, the expenses of management, which consist chiefly of cost of stationery and affiliation fees to the Agricultural Organisation Society, have been small—in 1911 they amounted only to 10*s.* 6*d.* for the year. And, since for the bulk of the society's transactions it borrows from depositors at 3 per cent., and lends to members at 5 per cent., it has a margin of profit on such transactions of £2 on every £100 every year. During the first year there was a loss, as the Society had to pay a registration fee of £1 (no fee is now charged for registration), but since then there has been a profit every year, beginning with 10*s.* in the second year, and ending with £4 17*s.* 11*d.* in 1911. Under the rules all profits must be carried to a reserve fund, which has gradually mounted up year by year, until in 1911 it was £69 14*s.* 4*d.*, including a gift of £15 made to the Society by the Chairman. The reserve fund is the property of the Society, which pays no interest on it, so that any interest received on this surplus is clear gain to the Society, and a further means of adding to the reserve fund. This fund cannot, under the rules, be divided among the members, nor can they derive any direct profit as sharers in the Society. Its uses are to give confidence to depositors, who see that the amount in reserve is readily available to meet their claims, and to the members, who feel that any unforeseen loss, such as the improbable failure of both borrower and sureties to repay a loan, can be met from the reserve fund without their having to contribute towards it. The interest on the reserve fund also goes to swell the income of the Society, and thus makes it possible to reduce the rate of interest charged on loans, as was done by the Society four years ago.

The Financial Position.

The financial position to which the Society has attained, as disclosed by its balance-sheet at the end of 1911, is highly satisfactory. It then possessed altogether £257, of which £153 had been lent out to members, and the remainder, which was in excess of the amount then wanted on loan by members, was mainly deposited with the Central Co-operative Agricultural Bank, Ltd., at 3 per cent. interest. Its liabilities were only £187 due to depositors, and on this it paid only 3 per cent. interest. So that, as already said, its surplus profits, or reserve fund, amounted to nearly £70. It has acquired such good credit in the neighbourhood as to obtain on deposit all the money its members require as loans, and its members can borrow the capital they want for agricultural purposes at the low rate of 5 per cent. per annum, or one penny per £ per month Few agriculturists in England can borrow at a lower rate than this.

At its last Annual Meeting the Society adopted the model rules recommended by the Agricultural Organisation Society, with slight modifications, and after reviewing its position and finding that its reserve fund amounted to more than one-third of the amount recently required for loans, and that it was being added to at the rate of about £5 a year, resolved to pay its Secretary, to whose care and attention much of its success is due, a small salary of £2 a year. And, seeing that it will still have a net income of about £3 a year, it may hope soon to be able, like the Hedge End Society, to reduce the rate of interest charged on loans to its members from 5 to 4 per cent. per annum, without encroaching on the reserve. It has recently proved its use in a bad season by making a loan to a member to enable him to buy sheep, without having to thresh and sell his barley, which will not be fit for the market before the end of the year.

It will thus be seen that the Scawby Credit Society, besides being the pioneer Agricultural Credit Society in England and Wales, may well be taken as a model of good and successful management by small agriculturists who wish to combine their personal credit, and so obtain loans for their agricultural operations at a low rate of interest.

Whitehall Place, London, S.W.,
March, 1912.

Revised, October, 1912.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Tomato-Leaf Rust (*Cladosporium fulvum*, Cooke).

THE destructive disease known as tomato-leaf rust, due to the parasitic fungus *Cladosporium fulvum*, Cooke, was first described by Dr. M. C. Cooke, from specimens received from North Carolina in 1883.

Its occurrence in this country was recorded by Plowright in 1887, when it proved very destructive to tomatoes grown under glass, in two different districts. Curiously enough, the fungus was not observed as a source of injury to tomatoes in the United States until the year 1888. It is now a well-known pest, attacking tomatoes in France and Italy also.

Description.

The leaves, stem, and occasionally the fruit, are attacked. The fungus usually first appears on the leaves, in the form of small scattered spots, which gradually increase in size and encroach on each other, until almost the entire under surface of the leaf becomes covered with a minutely velvety, dull rust-coloured layer, consisting of the spore-bearing portion of the fungus, the spawn or mycelium being imbedded in the tissues of the leaf. The presence of the fungus is first indicated by the appearance of pale yellowish patches on the upper surface of the leaf, corresponding in position to infected areas on the under surface. These yellowish patches increase in size, in proportion to the spread of the fungus on the under surface, and gradually change through brown to almost black, often with a tinge of purple. The fungus forms long, rust-coloured, afterwards blackish streaks on the stem, and more or less circular, scattered patches on the fruit. When the fungus shows a rusty tinge, the leaves wilt and soon die, and as a rule the disease spreads very quickly. This, to a very great extent, is due to the usual method of spraying horizontally, so that the spores are forcibly driven from one plant to another. If by any means the water could be allowed to fall from above, after the manner of a steady rain, numerous spores would be washed on to the soil, where they would germinate and perish, instead of being lodged on the leaves of healthy plants, where they set up new centres of disease.

Preventive and Remedial Measures.

Spraying with fungicides is of very little avail, unless commenced the moment the disease first shows on the foliage. The reason for this is that no fungicide is a curative agent; neither will it kill fungus spores. All that a fungicide can

do is to form a film of some substance on healthy leaves, and act as a poison to any *germinating* fungus spores that happen to alight on the leaf. Success in this direction depends entirely on the method in which spraying is conducted, the object being to cover the entire surface of every plant with the fungicide. To accomplish this object even approximately, repeated sprayings are absolutely necessary.

If the plants are young, half-strength Bordeaux mixture may be employed. When flowers and young fruit are present, a solution of liver of sulphur, 1 oz. in four gallons of water, should be used.

Whitehall Place, London, S.W.,
March, 1912.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of Application so addressed need not be stamped.

TOMATO-LEAF RUST (*Cladosporium fulvum*, Cooke).

Leaflet No. 263.

BOARD OF AGRICULTURE AND FISHERIES.

Mustard Beetles.

THE MUSTARD BEETLE (*Phaedon betulae*, L., or *cochleariae*, Fab., and *Phaedon armoraciae*, L.).

Among insect enemies of mustard, *Phaedon betulae*, L. is very destructive, both as adult and as larva ; the leaves especially are destroyed, but the shoots are also gnawed. Scarcely a year passes without some damage by this beetle, and now and again many acres of mustard are spoiled by it. In 1886 Miss Ormerod collated a number of replies from mustard growers concerning this and other insect enemies of mustard, and made a report, which was printed in abstract in the *Journal of the Royal Agricultural Society* for 1887, and more fully in the Ormerod Annual Report for 1887.

Phaedon betulae, usually known as the mustard beetle, chooses mustard as a favourite crop for feeding and breeding on, but also uses other Crucifers as food plants, *e.g.*, cabbage, rape, turnip, swede, cress, charlock. The beetle is found in England, Scotland, and Ireland. Complaints concerning it come to the Board chiefly from the east side of England, but in mid-June, 1904, adult beetles were sent from Bath, where they were destroying a bed of watercress.

Phaedon armoraciae, L., may also be found on mustard.

Description.

P. betulae (Fig. *a*) measures up to and may be over $\frac{1}{8}$-inch long. Its colour is blue or blue green ; the antennae, legs, and

b

MUSTARD BEETLE (*Phaedon betulae*).
a. Beetle × 3 ; *b*, Larva × 3.

underside of the body are dark. It differs from *P. armoraciae* in having a prominence at the base of each wing-cover less well marked or absent. The beetle may also be rather smaller.

The larva, or grub (Fig. *b*), is smoky or dull yellow in colour, spotted with black, and is somewhat hairy ; the head is black ; the legs are six in number, and are black, but there is, in addition, a muscular process at the hind end. Along each side of the body is a row of tubercles, brown in colour ;

from these tubercles yellow glands can be protruded. The length of the full grown grub is about ¼-inch. When newly hatched the grub is bright yellow, but the colour becomes dull.

P. armoraciae is broadly oval, and measures just over ⅛-inch in length. In colour it is shining metallic blue or deep green; the antennæ, legs, and under-surface of the body are black. Fowler adds as characteristic, "anal segment of the abdomen with a broad and bright reddish testaceous border." The thorax, narrower in front, is markedly punctured. The wing-covers also show many punctures, not only on the lines or striæ that run down the wing-covers, but also in the spaces between the striæ.

Life-History.

The adult beetles pass the winter in many different shelter-places in the neighbourhood of fields where the grubs have been at work—in such shelter-places as mustard stubble, hollow stems of wild plants, rubbish-heaps, at the base of rough grass, under bark, and in cracks in gate-posts and fences.

Issuing from their winter quarters in spring, the beetles lay yellow eggs on the under-sides of the leaves of mustard. The grubs feed on the leaves, and many may be found on a single leaf. Adult beetles have been sent to the Board in May, June, July, and August, and both young and old plants are attacked. The grubs, when full grown, drop away from the food-plants to the ground, and pass into the soil for pupation; in a fortnight the new adults may come above ground.

Treatment.

1. The beetles may be collected by shaking them off the plants into vessels containing paraffin, or into receptacles coated with tar. The most satisfactory plan for such trapping would be to use an implement that could be pushed between the rows; the implement would be provided with strips of canvas and a catching apparatus in the form of troughs or scoops situated low down, within 5 or 6 inches of the ground. The canvas strips would be so arranged as to hit against the plants as the implement was pushed between the rows, and thus the beetles be made to fall into the traps below.

Miss Ormerod wrote favourably of such a contrivance in her Report, 1894, while in 1911 an implement, in process of being perfected, was exhibited at the Lancashire Agricultural Society's Show. Such a trapping of the beetles as would ensure their being caught before they had laid their eggs would be specially advantageous.

2. Where great numbers of eggs have been laid on young plants a few inches in height, the wisest measure would be to plough in the crop at once, so as to bury the eggs.

3. Arsenate of lead would be a useful spray against the grubs, care being taken that the spray reached the undersides of the leaves. The arsenate of lead would be likely to poison any beetles that ate leaves sprayed with it.

4. Where the beetles are noticed to be migrating to other fields later in the year, a shallow trench should be dug across the path of the migrating swarm. If the trench be kept tarred many beetles will be caught.

5. After a bad attack by *Phaedon betulae*, the straw, where it has been left on the field, might, after lying for some time, be burnt in order to destroy sheltering beetles.

THE TURNIP, MUSTARD, AND CABBAGE FLOWER BEETLE

(*Meligethes aeneus*, Fab.).

This tiny beetle, belonging to a different family from *Phaedon*, is an enemy to the seed crop of various Crucifers. It injures the flowers, and hence reduces the amount of seed. Badly infested flowers shrivel. It is often harmful on mustard. It may occur alone, or it may be present with *Phaedon betulae*, and is found on both white and brown mustard. Thus on June 7th, 1909, a correspondent wrote: "I have eight acres of brown mustard, about a foot high, growing very fast. Yesterday I discovered all the tops of the plants covered with small black beetles." On examination these proved to be *Meligethes* and *Phaedon* working together.

Description.

The adult beetle is little more than $\frac{1}{12}$-inch long. It varies somewhat in colour, but typically is brassy green or deep green, with the thighs darker.

The larva is a grub with six walking legs on the thorax, and at the hind end of the body is a process which is of service in locomotion. The grubs are greyish or yellowish white in colour; the head is dark.

Life-History.

The beetles lay their eggs in the opening buds, and both adult beetles and larvæ may be found at work in the blossom; sometimes also on the outside of the plant. The grub, on being full-fed, falls to the ground, and enters the soil for pupation.

Treatment.

The shaking down of the beetles as recommended against *Phaedon*, would be of some service against this beetle. To trap the beetles in the blossom, however, would require more careful work. The most successful method recorded is from Austria, where boys are sent in among the plants with hand-nets. The net is held in one hand while with the other hand the flower heads are bent over and the beetles shaken into the net. The best time for this work is on quiet warm days from morning to mid-day. The nets are wetted in order to prevent the beetles from crawling out; at intervals they are emptied into receptacles into which boiling water is thereafter poured to kill them.

OTHER SPECIES OF *Phaedon*.

Phaedon tumidulus (Gerv.) is found on Umbelliferous plants, *e.g.*, on the wild cow parsnip or hogweed (*Heracleum sphondylium*). MacDougall has received it on two Umbelliferous crop plants. In July, 1905, it was sent from Yorkshire as harmful to celery. The correspondent wrote: "The beetles seem to commence operations at one end of a row of plants, and work steadily along the row, absolutely destroying the plants; the beetles are in hundreds." In August, 1905, it was sent to the Board from Settle, where, along with another *Chrysomelid*, it was destroying parsley.

Whitehall Place, London, S.W.,
June, 1912.

Leaflet No. 264.

BOARD OF AGRICULTURE AND FISHERIES.

The Cultivation of Onions.

Soil and Preparation.

The best soil for onions is a rich medium friable loam, though any good light soil, even if of a gravelly or silty nature, is suitable. Clay and clay loams should be avoided where possible, though moderate crops can sometimes be obtained on land of this type. Newly broken up grass land is quite unsuitable, not only because the crop will be liable to various insect attacks, but also because this soil produces "thick-necked" onions, that is to say, plants in which the parts above ground increase heavily in bulk at the expense of the bulb. Good results have, however, been obtained in the third season after the grass has been broken up.

The land should be thoroughly cultivated and freed from weeds before sowing. The importance of thorough cultivation cannot be over-estimated, and perhaps the greatest mistake in onion growing is the neglect of this precaution.

The land should be cultivated in October or November, and left in a rough state, so that it may benefit from the action of frost during the winter. Some growers recommend deep "bastard" trenching, but others consider that a "one-spit" digging or ploughing of about nine inches in depth is sufficient. If onions are grown at all frequently on the same land, trenching is without doubt the better plan.

The choice between the two methods depends largely upon the rotation practised, and on the area grown. Generally speaking, for extensive field culture, ploughing to nine or ten inches is more practicable, while for cottage garden purposes deep digging is recommended.

A difference of opinion also exists on the subject of manuring. Some growers apply a dressing of good half-rotten stable or cow manure at the rate of, say, 10 tons to the acre, while others who are equally successful, use artificial manures only. Some Bedfordshire growers have been known to apply as much as 50 tons of half-rotten stable manure per acre.

Manure should not be allowed to lie on the land for any length of time, as this encourages insects; *fresh* farmyard manure should never be used.

Where the grower has *only* stiff land at his disposal the advocates of deep trenching and the use of cow-manure recommend, in addition to a good dressing of short mellow manure, the application of a mixture of wood and cinder ashes with basic slag or lime, in the proportion of 7 cwt. of ashes and 10 cwt. of lime or basic slag to the acre.

It is not uncommon for onions to follow a crop of celery. The rotation in this case would be:—(1) Early potatoes or cabbage, the land being cleared in July; (2) celery; (3) onions. The advantage of this method is that the extra cultivation of the land, owing to the constant "moulding up" of the celery, and the heavy manuring of the trenches, bring the soil into an excellent condition to receive the onion seed. The land, as soon as the celery is off, should be dug and left until February or March. Good results may also be obtained with onions following corn, cabbage, carrots, or parsnips.

A dressing of 5 cwt. of superphosphate, and from 3 to 4 cwt. of soot per acre, is recommended immediately before sowing. Soot is particularly valuable. On light soils, which are apt to be deficient in potash, kainit at the rate of 5 cwt. to the acre should be added.

In February or March the land should be reduced to a fine tilth.

For culture on a large scale the land is harrowed and rolled, and finally it is often raked by hand for the purpose of obtaining an inch of fine soil to receive the seed. For cottage garden purposes, the land is raked, then rolled or trodden firmly, and lightly raked again ready for sowing.

The importance of a firm seed bed cannot easily be exaggerated.

Sowing and After-Cultivation.

A day should be chosen when the land is dry and workable. The seed should be sown thinly in drills about 9 in. apart and an inch in depth. The amount of seed required will be from 6 to 8 lb. per acre, depending upon the variety and the size of the seed, which varies in different seasons. The seed must be raked in lightly, and the back of the rake is sometimes used for this purpose. The ground should then be rolled, and again directly the plants are up in the rows, if the weather is dry.* Another dressing of soot or one of nitrate of soda is sometimes recommended at this point. Hoeing lightly is advisable to check seedling weeds and to aerate the surface soil.

As soon as the plants are large enough to handle, thinning should be commenced. The aim should be to have the plants ultimately from 4 to 6 inches apart in the rows, but it is not usual to complete the process at one operation. The first thinning may be done by hand, but the labour is often reduced by using a 2-inch hoe. The final thinning is given a few weeks later, and the plants then removed may be utilised for salad purposes. An advantage of prolonging the thinning in

*** The plan of raising the plants in autumn under glass and transplanting in spring is one that might well be adopted by small growers. One great advantage obtained by this method is the much greater freedom from attacks of "onion fly." (*See* Leaflet No. 31.)**

this way is that, even though a considerable number of plants are attacked by the Onion Fly in the early stage, the weight of crop is not necessarily seriously reduced, as sufficient sound plants may be left to give a full crop.

The hoe should be kept constantly in use, to prevent the growth of weeds In a damp season, when the tops appear to be making too much growth, it is advisable to bend them over with the hoe handle or something similar. This should be done about the first or second week in August. It is not advisable to perform the operation too early.

Harvesting and Storing.

Towards the middle of August it is well to determine, by pulling up a few bulbs, whether the crop is ready for gathering. If such be the case the bulbs come freely away from the soil, and the roots will be noticed to have withered. If new white roots are seen to be striking out from the bulb, the crop must be pulled without delay. This precaution prevents the possibility of what is known as second growth, namely, that of the new bud, lying between the swollen leaf bases of the bulb, and avoids the extra labour involved in lifting bulbs re-established by the new rootage.

Having determined when the crop is ready, the gathering should be done on the first fine dry day. A few rows are pulled, and the bulbs allowed to lie. Then the rows on either side of these are pulled, and the bulbs placed with those lying in the centre, so that as pulling proceeds there are alternate alleys of drying onions and of bare land.

During the drying, should the weather be showery, the bulbs should be constantly moved, to prevent second growth and the formation of fresh roots. When the bulbs are perfectly dry, they should be collected and stored either on a barn floor, or on specially constructed drying shelves. These shelves are placed along the length of the barn—one above the other, as in a book case—and are constructed of 3 in. laths placed lengthways about 1 in. or 1½ in. apart, to allow the air to circulate freely. The crop should be occasionally inspected—to see whether there are any signs of "sweating" or dampness. If such be the case, the bulbs should be regularly stirred—a little experience will soon enable the grower to judge whether such stirring is necessary or not. Among small growers onions are often "strung" or "sticked" for storing, one method being to take a stick about a yard long, and to bind the onions around the stick with string until the whole stick is covered. These sticks can conveniently be hung up in sheds.

Growing Pickling Onions.

There are several differences in cultivation when onions are grown for pickling. In this case the soil is prepared in

exactly the same way, but the drills are 7 in. apart, and a much larger quantity of seed (up to 60 lb. per acre) is used; no thinning of the young seedlings is required. Thus the density of the crop and the struggle for existence prevent the bulbs from attaining any but a pickling size. As a rule, however, large onion growers grade out the small bulbs from ordinary crops for pickling purposes rather than make a special cultivation.

In preparing for pickling, the small onions should be steeped in boiling water for a short time, then drained and allowed to cool. This makes peeling much easier. The onions, after being peeled, should be steeped in a strong solution of common salt for about a day, then carefully drained, and allowed to dry thoroughly. Finally, they should be put in bottles containing vinegar, which has been well spiced with cloves, peppercorns, coriander and ginger.

Production of Pickling Onions in Holland.

The growing of pickling onions on a large scale suffers rather severely from competition from Holland, and owing to various representations made to the Board of Agriculture as to the serious effects of competition from this source, investigations* were undertaken by the Board in the year 1902. These showed that the social and economic conditions under which the industry was conducted in the Netherlands differed in many respects from those existing in this country.

The secret of the success of the Dutch competition was, however, considered to lie mainly in the fact that the onions exported from the Netherlands presented, on the whole, a better appearance, and met more readily the requirements of the pickling firms.

Varieties of Onions Recommended.

(*a.*) For Market Purposes: White Spanish, Bedfordshire Champion, Giant Zittau, Nuneham Park, Rousham Park Hero, James' "Long-keeping." (*b.*) For Pickling Purposes: Silverskin, Queen Pickling.

Onion Pests.

The two principal pests of the onion, viz., onion fly and onion mildew, are dealt with in the Board's leaflets Nos. 31 and 178.

Whitehall Place, London, S.W.,
October, 1912.

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* Report on the Dutch Brined Vegetable Industry. [Cd. 1368], 1902, price 8*d.*, post free 9*d.*, from Wyman & Sons, Ltd., Fetter Lane, London, E.C.; or H.M. Stationery Office, 23, Forth Street, Edinburgh; or E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

Leaflet No. 265.

BOARD OF AGRICULTURE AND FISHERIES.

Rabbit Breeding for Small Holders.

Before the war the breeding of rabbits for food, both for home use and for export, was more or less common with the Belgian peasantry, and in the province of West Flanders rabbits were raised in such quantities that thousands of dressed carcasses were shipped weekly in the season to the London market. The imports of fresh rabbits in 1912, chiefly from Belgium, amounted to 43,915 cwt. and in 1913 to 43,614 cwt., and the total imports of fresh and frozen rabbits from all countries in the years mentioned were 430,925 cwt. and 525,578 cwt. respectively. Owing to the Belgian supplies being cut off, the imports of fresh rabbits in 1915 dropped to 8,727 cwt., while in the same year the total imports of fresh and frozen rabbits amounted to 603,659 cwt.

It is evident from these figures that rabbits form an important article of diet in this country and, now that Continental supplies have been so greatly reduced owing to the war, rabbit keeping should prove a remunerative industry.

Owing to lack of organisation in marketing and to a widespread prejudice against the tame rabbit, there was formerly some difficulty in disposing of the produce at good prices. This difficulty, however, has now been largely overcome. There is a demand for tame rabbits in London, and they are sold at Leadenhall and at the Smithfield poultry market, but the best prices are paid by retail butchers and poulterers. Markets are also found in the North, at Sheffield, Manchester, &c., and especially in towns in mining districts.

Suitable Breeds.

The most suitable rabbits for table purposes are the Flemish Giant and Belgian Hare, both of which combine the necessary characteristics of early maturity and good size. At present, however, there is a distinct shortage of these breeds, and prospective rabbit keepers may find it difficult to purchase their stock at a reasonable price. It will be necessary therefore to make greater use of cross-bred rabbits; these should be mated with heavy pure-bred Belgian Hare or Flemish Giant bucks. The smaller fancy varieties, such as the Dutch, Silver Grey and English, might also be kept more extensively for table purposes than they are at present; they will not altogether fulfil requirements as regards size, but the quality of the flesh will compare favourably with the better known table varieties.

While these breeds may be used exceptionally for table purposes the only two breeds which can be generally recommended are the Belgian Hare and the Flemish Giant.

The Flemish Giant Rabbit.—This is the largest breed of rabbit, and show specimens may weigh anything from 11 to 18 lb. The standard of the National Flemish Giant Rabbit Club, which follows, explains the general characteristics of this breed :—

Size and weight to be as large as possible, bucks not less than 11 lb., does not less than 13 lb. 30 points.
Colour : Dark steel-grey, with even, wavy ticking over the whole of the body, chest, and feet alike ; belly and underpart of the tail pure white. 20 points.
Head and ears : Head to be large, full, and shapely, with large, bold eyes, dark brown in colour ; ears to be carried erect, moderately thick ; head and ears to be of the same colour as rest of body. 10 points.
Body : Body to be large, roomy, and flat, with broad fore and hindquarters. Does to have a dewlap, evenly carried. 15 points.
Condition : Full short coat, firm in flesh. 10 points.
Legs and feet to be strong in bone, large and straight, colour to match body. 15 points.
The chief faults are sandy brown or red colour ; small size ; barred feet ; camel back ; narrow, wedge head ; bowed legs ; lapping ears.
Maximum number of points, 100.

When purchasing, it is desirable to go to a well-known and reputable breeder, and see the rabbits before buying them. In the case of does, the type of rabbit required is one that is prolific, a good mother, and a hardy animal bred from a massive strain. The standard says that bucks must not be less than 11 lb. and does not less than 13 lb., but for table purposes from 9-12 lb. will be found a desirable weight. While show specimens are not required, pure bred stock is essential, for the reason that unless the animals are bred true, desirable qualities, such as size, weight, &c., will be absent. It must not be forgotten also that by breeding pedigree stock, the rabbit breeder has two markets, *viz.*, for breeding and for table purposes.

The Belgian Hare.—The Belgian Hare (which is, of course, a true rabbit and not a hare) is a very different rabbit from the Flemish Giant, as the following standard, set by the National Belgian Hare Club, will show :—

Colour : Rich rufous red, carried well down sides and hindquarters, and as little white under the jaws as possible. 20 points.
Shape : Body, long, thin, and well-tucked-up flank, and well ribbed up, back slightly arched, loins well rounded, head rather lengthy, muscular chest, tail straight, not screwed, altogether of a racy appearance. 20 points.
Ticking of rather a wavy appearance and plentiful. 10 points.
Ears about five inches, thin, well-laced tips. 10 points.
Eye hazel colour, large, round, bright and bold. 10 points.
Legs and Feet : Forefeet and legs long, straight, slender, well-coloured, and free from white bars ; hind feet well coloured. 10 points.
Dewlap : None. 10 points.
Size : About 8 lb. 5 points.
Condition : Perfectly healthy, not fat, but flesh firm, like a racehorse, and good quality of fur 5 points.
Maximum number of points, 100.

It is probable that the chief disadvantage of this breed lies in the fact that many Belgian Hares are anything but hardy. This is due to "breeding in-and-in," which, though securing good colouring, fine limbs, head, &c., has resulted in some sacrifice of stamina. If, however, good-sized animals are obtained, not strictly show specimens, the offspring are very satisfactory, as the breed is certainly prolific and the does are generally good mothers. The chief value of the Belgian Hare lies in the first cross. If a massive Flemish Giant buck is mated with a large, well-built Belgian doe, the resulting young are excellent table rabbits—indeed, they are by many breeders claimed to be the best.

Breeding.

Does may produce from three to ten young in a litter, but about 20 youngsters per annum is an average for the usual breeding rabbit. The best time for breeding is undoubtedly the spring and summer, but if the rabbits are properly housed and well looked after, breeding may proceed throughout the winter. More care is necessary in the upbringing of any litters that may be born in winter, but with a fairly large head of stock, it would probably be safe to assume that a proportion of the does would breed throughout the colder part of the year, particularly if encouraged by warm housing and judicious feeding.

Fattening.

The fattening of table rabbits is important, the object being to place on the market at the end of fourteen weeks or so a rabbit that will yield a dressed carcass of 2½ to 3 lb. of meat. Fattening starts from the day the young are born, for the more and the richer the milk the doe gives her litter, the larger will the youngsters be when they leave the nest about 16 or 20 days later. After this period they soon start eating when the doe's food is placed in the hutch. Nothing should therefore be given that is in any way likely to affect them adversely, such as damp greenstuff, whole grain, &c., but the actual fattening foods may be practically the same from this time until the rabbits are fit to kill.

The following are among the most useful foods :—Sharps or coarse middlings, broad bran, pollards, ground oats or barley meal, chaffed clover hay and long meadow hay. The mash should be a crumbly mass and not wet or sloppy. A good dietary for fattening stock would be as follows :—

Morning.—(1) Chaffed clover hay, mixed with warm boiled potato parings, and dried off with a few handfuls of sharps or pollards ; or (2) a mash composed of two parts bran and one part coarse middlings.

Evening.—Sliced or pulped roots (swedes, mangolds, &c.), with meal or chaffed hay, or greenstuff in season.

Well-dried greenstuff may be used, but care must be taken to exclude wet and frosted or decayed leaves, &c. Grass, cabbage leaves of all sorts, together with the thinnings and outside leaves of all garden produce may be used, and in season the many forms of wild green weeds, such as dandelions, plantains, hogweed, chickweed, dock, and others. Mashes may always be served warm, but not too hot, and rabbits should always have fresh, clean water to drink.

Marketing.

The time taken to prepare a rabbit for the market cannot be definitely stated, as even in a litter of five rabbits, two or three nearly always do better than the others, and reach the required weight at about 10 or 12 weeks old, while the others will need 14 or 15 weeks. With regard to weight, the small holder should study local conditions. It is safe to assert that carcasses weighing 8 lb. are practically unsaleable. A rabbit weighing alive from 4 to 5 lb. is probably the most satisfactory size. This will give a dressed carcass of from 3 to 3½ lb. It must be remembered that the class of buyers who purchase well-fed table rabbits would look with more or less disfavour on a dressed carcass of 5 or 6 lb., as they would regard it as likely to be an old rabbit. The rabbits should be bled as soon as they are killed, otherwise the bruise in the neck (caused by the actual killing) will seriously depreciate the value of the carcass. The carcasses should on no account be packed before they are quite cold.

Some poultry dealers prefer to buy the rabbits alive, killing as they require, and in this case it is customary for the producer to deduct one-third of the live weight of each rabbit for pelt and offal. Small holders should endeavour to sell direct to the retailer, or, better still, to private customers.

NOTE.—The housing and general management of table rabbits are dealt with in Leaflet No. 301.

Whitehall Place, London, S.W.,
November, 1912.
Revised, February, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 266.

BOARD OF AGRICULTURE AND FISHERIES.

Ropy Milk.

Of the many abnormal changes which sometimes take place in milk, one of the most common and persistent is that which gives rise to what is called "ropy" or "slimy" milk. Such milk, when poured from a jug, has a rope-like form. A spoon or wire dipped into the milk and then taken out draws after it thread-like strands sometimes more than a yard in length. Such an abnormal appearance naturally alarms the consumer, while the persistence of the trouble frequently causes great loss to the producer or retail seller. The ropiness which appears in the mixed milk of a herd several hours after milking, and which increases on allowing the milk to stand, is due to the growth of bacteria, which, as a general rule, gain access to the milk after it has left the udder of the cow, though in a few instances they may exist in the udder before milking. This kind of ropy milk, though abnormal and prejudicial from the seller's point of view, is quite wholesome and does not endanger public health.

"*Garget*" *Milk.*—Ropiness, however, is sometimes observed in milk from individual cows, notably in cases of inflammation of the udder. In such cases the cause may be either bacterial or non-bacterial. If the ropiness does not increase when the milk is kept and cannot be propagated by transference into another sample of fresh milk, it is probably due to the presence of fibrin and white corpuscles from the blood, which form masses of slimy material in the milk. Such milk ("garget" milk) may not cause other milk to become ropy, but organisms are present in the milk which may lead to infection being spread from one cow to another by the hands of the milker. For this reason prompt attention should be given to all cows suffering from this disease, and all sources of infection avoided. Milk of this nature should not be used for food.

In this leaflet the description "ropy milk" is confined to the first type of milk referred to; the leaflet does not deal with "garget" milk.

Ropy Milk Organisms.—The organisms causing ropiness are very numerous and may be divided into two broad classes:—(1) Those which, in sterilised milk, possess the property of dissolving the casein, making a thick, honey-like solution when grown for some time. These organisms tend to produce an alkaline reaction in the milk, though

some produce a little acid. In general they require a large amount of oxygen. (2) Those which do not dissolve the casein, but which, by means of the acid they produce, precipitate it (these include certain ordinary lactic bacteria). The quantity of acid produced in milk by these organisms is in some cases very large. These organisms are able to grow much better without air than the other type.

Tests to be used in cases of Ropiness in Milk.

On the appearance of ropiness it should first be ascertained whether the outbreak is caused by bacteria by adding a few drops of the affected milk to some sound new milk in a clean glass. This glass should then be placed in a warm room and kept loosely covered to prevent dust getting in. The time taken for ropiness to appear should be noted, and is of the greatest importance from a practical point of view, since it can be assumed that ropiness which does not appear until after three days would not affect the sale of the milk.

The cows should be examined, and samples taken in clean glasses from the milk of individual cows and from the mixed milk after straining, cooling, &c. The time taken in each case for ropiness to appear should be noted.

To a glass of clean fresh milk from another source should be added some of the water used for washing the churns and pails, and to yet another glass some of the water which the cows drink. A glass of this milk should also be left exposed in the dairy.

The results of these experiments would probably indicate the source of the trouble, and the measures prescribed below for dealing with the discovered source of infection should be carried out. On an outbreak of ropiness, however, it would be as well to adopt the whole of the following precautions :—

Preventive and Remedial Measures.

The bacilli causing ropiness are frequently found in water. Special care should, therefore, be taken in washing the milking pails, strainer cloth, &c., after each milking. When thoroughly clean these should be well scalded and *should not again be rinsed with cold water*. It is well to scald the pails, &c., shortly before milking. Great care should be taken that no water is splashed into the milk in the process of cooling, &c.

Dust is also sometimes a carrier of the bacilli. The pails, &c., after washing should, therefore, be kept upside down, and the milk when it is in the pails should be kept covered as much as possible.

The rooms where the milk is kept should be well cleaned. Wooden, cement, or stone floors may be cleaned with a mixture of five parts of commercial sulphuric acid to ninety-five parts of water, but care should be taken that this does not get on the clothes of the person using it.

Wooden vessels should not be used for milk, as they may persistently retain the ropy milk organisms. It is inadvisable to use wooden troughs even for washing milking vessels, but when they are used special care should be taken to clean them each time after use.

Dilute solutions of washing soda favour the growth of the organisms, and it would be better to use sodium hypochlorite or some other cleanser and disinfectant in cases of an outbreak of ropy milk.

Straw, mouldy hay, and also Butterwort, have been shown to hold ropy milk organisms, and the custom of wiping the udders of the cows with a wisp of straw before milking is a bad one. After washing their hands for milking, milkers should not handle straw or fodder, nor should any such material be brought into the cow-byre just before or during milking.

The organisms may be transferred to cows from water in which they have been standing, or which has otherwise been splashed on their flanks or udders. The cows should, therefore, be kept clean; and ponds should be fenced off so that the cows cannot wade in them.

On the first indication of an outbreak of ropy milk the cows should, if possible, at once be turned into another pasture.

NOTE.—A fuller account of Ropy Milk was given in the *Journal of the Board of Agriculture* for March, 1912, p. 991.

Whitehall Place, London, S.W.,
March, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Basic Slag.

The great importance and extensive sale of basic slag as a manure make it desirable to remind intending users of a few points as to its purchase, and its use on different soils and crops.

As a cheap and effective agent in the improvement of much of the poor grass land, the use of basic slag merits greater attention, especially in view of the possibility of increasing the area under tillage in the future. The improvement effected by the slag is to be measured not only by the immediate results, such as the increase of herbage, or of meat or milk, but also by marked increase in the fertility of the soil lasting over a period of years. An application of from 5 to 10 cwt. of basic slag per acre entails little labour, and although there may be some delay at present in obtaining supplies owing to congestion on the railways, this difficulty can be largely surmounted by foresight in ordering.

Basic slag, as is well known, owes its value to the fact that it contains phosphate of lime in a more or less readily available condition. It usually contains also a considerable proportion of lime capable of neutralizing acids in the soil, though probably not more than 2 to 5 per cent. is in the form of "free" or "caustic" lime. Obviously, then, the first thing to be ascertained in buying basic slag is the percentage of phosphate of lime which it contains. Furthermore, the availability of the phosphate in different samples varies. As an indication of the rate at which the phosphate is likely to become "available" or useful to plants a method often adopted, and officially recognised under the Fertilisers and Feeding Stuffs Act, is to ascertain the percentage soluble under standard conditions in a 2 per cent. solution of citric acid.

Fineness of Grinding.—As influencing the availability, the fineness of grinding is extremely important. In addition, therefore, to the guarantee of the amount of phosphate present, a statement as to the proportion of the slag which will pass through a sieve having 10,000 meshes per square inch should be obtained. This proportion should be not less than 80 per cent., and samples 90 per cent. of which will pass through the sieve are readily obtainable.

Most Suitable Grade of Basic Slag.—There is often discussion as to what is the most suitable quality of basic slag for general use. It is possible to obtain slag called basic slag containing very little phosphate at all, while on the other

hand the richest samples contain up to 50 per cent. of "total phosphate of lime." The solubility of this total phosphate, however, varies very much in different samples, and there is no definite relation between the richness of slag in phosphate and its solubility. For instance, in one of a series of samples of which detailed analyses are available, the total phosphate of lime amounted to 27 per cent., and 93 per cent. of this was soluble in a 2 per cent. solution of citric acid; in another containing 45 per cent. total phosphate of lime, only 70 per cent. was soluble; in still another sample, containing 20 per cent. total phosphate of lime, only 66 per cent. was soluble.

The question of which quality should be used is chiefly one of cost. From the crop's point of view, what is required is a sufficient supply of phosphate, and whether this is supplied by a small quantity of a high quality slag, or a large quantity of a low quality slag, is immaterial. Every farmer intending to use basic slag should obtain quotations for different grades from one or two merchants, and calculate what 1 per cent. of citric-acid-soluble phosphate would cost him in each case. Supposing, for example, two grades of slag, containing 20 per cent. and 34 per cent. "citric soluble phosphate" are offered at 46*s.* and 75*s.* a ton respectively; the cost of 1 per cent. or 1 unit of citric-acid-soluble phosphate in the first case is 46*s.* divided by 20, or 2*s.* 3¼*d.*; in the other case it is 75*s.* divided by 34, or 2*s.* 2½*d.* Clearly the latter is the cheaper manure. Sold on a basis of total phosphate, basic slag containing 20 per cent. of phosphate is costing, at present, about 42*s.* 6*d.* a ton or 2*s.* 1½*d.* a unit, and 42 per cent. quality is costing about 77*s.* 6*d.* a ton or 1*s.* 10*d.* a unit. Whether valued, therefore, on the basis of the content of citric soluble phosphate or of total phosphate, the higher grade slag is the cheaper article in the particular cases here mentioned and, generally speaking, it may be said that the higher grades of slag are really cheaper than the lower grades, particularly when the greater cost of carriage, carting, and distribution of a given quantity of phosphate is taken into account. As to which is the better basis on which to purchase basic slag something will depend upon the crop. Thus, for the root or other rotation crop, a highly soluble slag, on account of its quicker action, would probably give a better return than one of low citric solubility, but in the case of pasture and lucerne, where the return is spread over several years, the question of citric solubility has less significance, and the question of cost of phosphate should be the chief determining factor. Even in the case of pasture, however, the highly soluble slag should be preferred in districts with a low rainfall.

Soils.—Basic Slag usually gives its most striking result when applied to poor pasture on heavy clay soil. The results obtained at Cockle Park and detailed in a supplement to

the *Journal of the Board of Agriculture and Fisheries* (January, 1911), are most striking. The effect of slag is, however, by no means confined to poor clay soils. Excellent results have followed its use on the light soils of the South Downs, and wherever the natural conditions favour the growth of white clover slag is likely to benefit pasture. The alkalinity of the slag renders it also a very suitable manure for peaty and sour soils. Even very light soils deficient in lime sometimes respond well to an application of slag.

Crops.—While basic slag may be regarded as a suitable source of phosphate for all kinds of crops it usually gives best results with those of slow-growing habit. As compared with superphosphate the choice is more a matter of soil than of crop. Basic slag is used in preference to superphosphate when soils are acid and there is danger of cruciferous crops (turnips, &c.) being affected with Finger-and-Toe.*

Time of Application.—When used for a turnip crop basic slag is best applied in the drills in spring, but when used for permanent grass land, it is most suitably applied in autumn or early winter, as it is then washed down into the ground before growth starts in the following spring. Generally speaking, October, November and December are the best months, but January and February are not unsuitable, and there is no fear of loss by drainage or by exposure to the atmosphere whatever be the time at which the manure is applied.

Quantity per Acre.—In the ordinary use of manures the most economical system is to give repeated applications of comparatively small quantities rather than large dressings at one particular time; the case of slag applied to grass land, however, is usually different. Basic slag does not act on the grasses of a pasture directly, but indirectly, by first encouraging a strong growth of white clover and leguminous plants, which in their turn enrich and improve the soil in different ways. This growth of white clover is most readily brought about when the pasture is in a poor, unimproved condition, as then the clover has room to develop, and meets with comparatively little competition. The aim should therefore be to get the maximum growth of white clover at once, and it is advisable to try a comparatively large dressing of slag (say, from 7 to 10 cwt. per acre, according to quality) at the outset, rather than a moderate quantity of 3 to 5 cwt. with the intention of repeating the dressing in two or three years. Surprise is frequently expressed at the development of white clover; very often there is apparently none at all in the unimproved pasture. The explanation is that plants are usually present, but as they are very small and dwarfed by

* See Leaflet No. 77 (Finger-and-Toe in Turnips).

unfavourable conditions, they are quite concealed from casual notice by a coarse growth of bent or other grass. Occasionally, however, it may happen that there are none of these small, suppressed plants present, in which case the slag cannot exert its effect. Such a case is rare, but if it does occur, a little wild white clover* seed should be sown in the spring following the application of the manure; a lb. or two per acre would be sufficient, and to give it a chance of germination it should be sown fairly early, and the ground thoroughly harrowed before sowing, and well rolled afterwards.

It is suggested that a heavy dressing, the effect of which might be expected to last some considerable time, is better than repeated applications of small quantities, but it does not follow that when the effect of the first application is beginning to disappear a second application would not prove profitable and desirable; in many cases where a second application has been given after five or six years, the effects have been very good and profitable, though naturally not so striking as those attending the first manuring.

While basic slag usually gives excellent results under the conditions indicated above, it is desirable in those cases in which local experience may be lacking to treat a small area and test the value of the manure before purchasing large quantities. On light soils, in addition to trying the effect of slag alone, it is also advisable to test the effect of adding kainit, when available, (at the rate of 3 or 4 cwt. per acre). Potash is seldom required on heavy clays, but may be needed just as much as phosphate on light soils. On the poor pastures on which slag proves effective, nitrogenous manuring, either in the form of dung, nitrate of soda, or even cake feeding, seldom does good and often does harm. The improvement of such pastures is best effected by encouraging white clover; direct application of nitrogenous manure tends to help the grass to suppress what little clover is present.

Danger to Stock.—The idea is sometimes entertained that basic slag, if taken even in small quantities, may be highly injurious to stock; it may, therefore, be observed that there is practically no danger of special injury resulting from the consumption of small quantities. Care should be taken however, to distribute the slag evenly, and it is advisable to wait until a heavy shower has washed most of the slag off the herbage before turning stock into the pasture.

Whitehall Place, London, S.W.,
January, 1914.
Revised, September, 1916.

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*Articles on Wild White Clover appeared in the *Journal of the Board of Agriculture* for December, 1909, and February, 1916.

BOARD OF AGRICULTURE AND FISHERIES.

The Cultivation of Field Beans.

The Field Bean must be considered one of the most valuable of farm crops, and one which deserves more attention at the hands of farmers. With the advent of the self-binder a former difficulty, that of cutting the crop by hand, has been overcome. Though the crop is well known to farmers generally, yet the acreage grown is comparatively small. In 1912 the total area* of beans in England and Wales was 277,001 acres—a decrease of 24,453 acres compared with 1911—and the average for the 10 years 1902-11 was 266,939 acres. In the year 1912 there were grown in England 2·6 acres of beans in every 100 of ploughed land, while in Wales there were ·2 acres of beans per 100 arable. The relative extent to which the crop is cultivated in English counties will be seen from the following table relating to the acreage of 1912 :—

County.	Acres of Beans per 100 Acres Arable.	County.	Acres of Beans per 100 Acres Arable.
Bedford	8·1	Buckingham ...	4·3
Huntingdon ...	7·4	Hertford ...	3·7
Suffolk	7·1	Rutland	3·5
Northampton ...	6·5	Oxford	3·2
Essex	6·2	Middlesex ...	2·4
Warwick	5·7	Leicester ...	2·3
Cambridge ...	5·3	Nottingham ...	2·1

It will be seen that even in Bedfordshire, Huntingdonshire and Suffolk, the highest upon the list, the acreage is not very large.

The bean, being a leguminous plant, naturally takes the place to some extent of clover, and being under certain conditions a cleaning crop, it can replace a fallow, but it is a better plan to ignore the latter possibility and consider it only as a leguminous crop. It is not suited to the lighter soils and is grown almost exclusively upon clays and the heavier loams, particularly those which contain an appreciable amount of lime. Among other reasons, this fact, as well as the difficulty formerly experienced in cutting, is largely responsible for the limitation of the acreage.

* Including a certain proportion for human consumption.

In many districts where beans are grown, red clover seed is also a common crop. Experience has shown that, if the land is farmed upon the standard four-course rotation, the red clover will not be successful every fourth year, but will produce a good crop when grown at eight year intervals. In this way an eight-course rotation has originated, in which beans replace red clover. In this rotation during the eight years there are four white straw crops, two fallows, and two leguminous crops.

Varieties.—The varieties, especially seedsmen's varieties, are not at all numerous, and can be divided into two main classes, namely, winter and spring. There are more kinds of the latter than the former, the chief being the Black Eyed, the White Eyed, the Heligoland, the Mazagan, the Tick, the Cluster, and the Red. There is a very large amount of purely local prejudice in favour of the different kinds, but in experiments at Ridgmont the Red Spring variety has produced the most profitable results on a typical bean soil. Change of seed from a different district in England may produce only a very slight increase, if any. over home-grown seed. Seed from similar soils in Lincolnshire, Essex, Suffolk, Buckinghamshire, Oxfordshire and other counties has been used for comparison with home-grown seed in Bedfordshire, but the results did not show that the seed from any one district was to any noticeable extent preferable to that which was home-grown. At the same time it is probably advisable to obtain a change of seed periodically, and to get it from a different class of soil. Seed from a light loam or chalky soil seems likely to make a very good change on heavy clay.

Cultivation.—Coming between two white straw crops, the cultivation will to a certain extent be that of a fallow crop, and thus it will vary rather considerably in different districts.

With *winter beans* the more generally accepted practice is to give the land a light dressing of farmyard manure, some 8 to 10 tons per acre, which is drawn on to the stubble and spread as soon as possible after harvest. This is ploughed in to a medium depth, say 5 to 6 inches. After harrowing, the seed is drilled at the rate of 2 to 2½ bushels per acre, in rows some 20 to 22 inches apart. The earlier the crop can be sown the better, and if it is impossible to sow before the end of October, the better plan is to wait until later in the season and sow a spring variety. During a wet autumn, beans may be ploughed in. This is done by dropping the seeds just in front of the mould boards from a small hopper attached to the plough. The seed, thus covered in, is sown along alternate furrows, the land being subsequently harrowed. By this means the ground is not trampled by the horses to any great extent.

In bygone days it was the custom to dibble beans, especially on heavy, poorly drained soils, and in certain districts this custom still lingers; except for the question of expense it is a highly satisfactory method of sowing. The custom was for the man doing the work, having set two lines about 20 inches apart as guides, to walk backwards across the field with a long-handled dibber in each hand making holes every eight or nine inches; two boys followed him, dropping two or three beans in each hole; on reaching the far side he shifted the lines and walked back kicking in the seed holes; a good man with two boys could do one and a half acres in a day.

With *spring beans* the land usually receives a similar dressing of farmyard manure, but the work can be done as opportunity occurs, so long as the land is ploughed up by about the end of the old year, that is, in time to allow of "weathering." No further cultivation is needed until just before sowing, which should be done as early as possible after the beginning of February. The mechanical condition of the land should be taken as a guide, for the soil should be dry and friable, so that the seed can be drilled a fair depth and well covered. Some growers prefer to postpone sowing until a month later, as there is less danger of the young plants being injured by a late frost, but, taking all things into consideration, early sowing is better, because the early sown crops are less liable to be ruined by the bean aphis,* while in the case of a heavy clay soil an opportunity of sowing under first-rate conditions will probably not occur twice in one season.

Spring beans are drilled at about 21 inches apart, using three bushels of seed, except with the Cluster variety, which is sown at 10 to 12 inches apart. Repeated trial has shown that this narrower distance gives a larger yield, and many good farmers go a step farther and drill all the spring varieties at this short distance apart; but this prevents the land being horse-hoed, except with a corn horse hoe, and it is found in practice that this excellent implement does not do good work on heavy soils with narrow, high-backed "lands." The followers of the close row method argue that beans, coming only two years after a fallow shift in the rotation, should not require horse-hoeing; theoretically this may be true, but it must be remembered that not infrequently the weather does not permit the fallows to be thoroughly cleaned. Under such circumstances, for the sake, not only of the beans themselves, but also of the wheat following, it is essential that every effort should be made to keep the land as clean as possible. The horse-hoeing should begin early, and it is very

* See Leaflet No. 104 (*Aphides or Plant Lice*).

beneficial to use plain curved tines similar in shape to those on a steam cultivator, instead of the ordinary duck-foot and L-shaped hoes for the first hoeing; a second, and *occasionally a third*, hoeing is given, the ordinary hoes being used. Between the first and second horse-hoeing the crop should be hand-hoed. In this way the land is kept as *clean as the weather will permit.*

Manures.—Beans respond well to an application of farm-yard manure, but do not as a general rule *give a profitable return when "artificials" are used. Being leguminous plants they are not expected to respond to a nitrogenous* dressing, nor are good results obtained, in the vast majority of cases, from either phosphatic or potassic manures. The late Mr. James Mason, of Eynsham Hall, Oxon, did, however, get excellent results from an application of 5 cwt. basic slag and 5 cwt. kainit per acre, upon some stiff clay soils in that district. This was borne out by trials at Cockle Park in 1907, when basic slag by itself and also in conjunction with muriate of potash, produced quite satisfactory results. In the rotation experiment at Saxmundham, where beans alternate with red clover every fourth year, the farmyard manure plot is distinctly the best, whilst a phosphatic and potassic dressing, viz., 2 cwt. of superphosphate and 1 cwt. of muriate of potash, also produces excellent results; it is noteworthy that at this centre the application of nitrate of soda is practically useless.

Harvesting is easier than in the case of white straw crops, because the same degree of dryness is not required. The crop is cut when the leaf has fallen and the lower pods are blackened; the cutting can be done with the binder in the majority of cases, but occasionally when the straw is very short and the lowermost pods are close to the ground, the cutting must be done either with a reaper or by hand. When using a binder it is advisable not to use new knives or canvases.

Either eight or ten sheaves are placed in each shock, and the carrying should not take place for a week or ten days, when, under favourable conditions, the straw will be sufficiently dry and seasoned. The carrying should be done on a dull day or early in the morning before the dew has disappeared; if done when the sun is shining brightly the pods may split open and a considerable amount of the grain be shed. It is a great advantage, if possible, to have some beans and oats ready to cart at the same time, so that a beginning can be made in the early morning with the beans, and when the sun is fully up and bright the work may be transferred to the oat field.

Rectangular ricks some four or six yards wide are usually built. The stubbles give a very good picking for the ewe

flock, and if the crop has podded low on to the ground or a considerable amount of grain has been shed, it is a good practice to turn out some store pigs to work over the stubble and glean what would otherwise be lost.

Thrashing for seed corn should be done when the grain is hard and dry; it is essential that the drum be set fairly wide, otherwise a large number of grains will be split. When the beans are required for consumption this splitting is an advantage rather than otherwise, because it shows that the grain is sufficiently dry and hard to grind well.

Yield.—Five quarters is considered a good crop, but, owing to insect attack and other causes, the yield may be as low as three quarters per acre.

Use of Beans as a Food for Farm Stock.—Old beans are a better and more economical food than new ones, and it is therefore advisable to postpone the thrashing of the bulk of the crop until March at the earliest, and for preference until the rick has been standing at least twelve months. Beans are a most useful food upon the farm, as when used with judgment they are suitable for all classes of stock. It is better to mix the beans with other concentrated foods, particularly with oats. Large quantities of bean-meal given to milch cows tend to prevent the cream from churning in a satisfactory manner. A few whole beans are very useful when given to growing store pigs, but the use of large quantities of bean-meal when fattening them should be avoided, or the lean meat will be hard, and the bacon when cured will not be of the highest quality. Bean cavings make an extremely good fodder for horses and sheep, but it is not advisable to use the straw for this purpose, as it is likely to cause digestive troubles.

Insect Pests of Beans.—The chief enemy of the bean crop is the aphis, which attacks the leaders of the plants early in the summer, greatly lessens the yield, and in many cases ruins the crop. When a bad attack occurs there is no cure, but the best preventive is to have the plants in strong, vigorous condition, to obtain which early sowing on land in good heart and well tilled is the only sure method. (*See also* Leaflet No. 104.) Other pests are the Bean Weevil (Leaflet No. 19), Bean Thrips (Leaflet No. 48), and Bean Beetle (Leaflet No. 150).

Whitehall Place, London, S.W.,
April, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 269.

BOARD OF AGRICULTURE AND FISHERIES.

Diseases of Raspberry and Loganberry.

During recent years the canes of raspberries and loganberries have been observed to suffer to a considerable extent from the effects produced by microscopic, parasitic fungi, which are stated to be yearly extending their range of activity. The fungi implicated have been known for more than half a century as parasites on wild roses, brambles, and other rosaceous plants, and their rapid extension during recent years does not imply any increased power of parasitism, but is simply due to the increased number of suitable host-plants grown in juxtaposition.

Hendersonia rubi, Westendorp, is responsible for most of the injury caused to raspberries and loganberries. The canes or stems are the parts attacked, infection taking place during the summer, when the young growth is tender. The first indication of the presence of the parasite varies to some extent with the particular variety attacked, but as a rule lurid red or purplish patches of variable size appear on the stem. Such patches continue for some time to increase in size, and during the winter change to a pale grey or dingy white colour, due to the bark having been killed. At this stage the fruit of the fungus, in the form of minute black dots, is thickly scattered over the dead, white patches of bark. Microscopic examination shows that the minute black fruits contain myriads of coloured, four-celled spores. When mature these spores escape into the air, and those that happen to alight on young shoots germinate and enter the tissues, thus ensuring the continuance of the disease in the following season. When several diseased patches are present the canes are killed outright during the winter, whereas when only one or two diseased areas are present, the cane may survive and produce a certain amount of fruit. As the spores of the fungus, however, will be present in such cases, it is sound policy, even at the sacrifice of a certain amount of fruit, to remove and burn all canes, however slightly attacked, as it is only by such means that the disease can be eradicated. Infection mostly takes place at the period of the year when fruit is present, hence spraying cannot be resorted to unless the fruit is sacrificed, when Bordeaux mixture should be used. Even in these circumstances

DISEASES OF RASPBERRY AND LOGANBERRY.

Fig. 1.—Raspberry, showing pale, dead areas, caused by *Hendersonia rubi*. Nat. size.

Fig. 2.—Spores of *Ascochyta pallor*. Mag.

Fig. 3.—Raspberry, showing small, pale dead areas, caused by *Ascochyta pallor*. Nat. size.

Fig. 4.—Spores of *Hendersonia rubi*. Mag.

Fig. 5.—Loganberry, showing pale, dead area, caused by *Hendersonia rubi*.

every diseased cane should be cut down the moment it is observed. The practice, common in many places, of allowing the dead canes to remain standing throughout the winter, is to be condemned.

A second fungus, *Ascochyta pallor*, Berk., sometimes occurs as a parasite on the stems of raspberries, roses, and brambles. It forms whitish dead patches, studded with black dot-like fruit. Treatment should be similar to that suggested against *Hendersonia rubi*.

Whitehall Place, London, S.W.,
April, 1913.

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Leaflet No. 270.

BOARD OF AGRICULTURE AND FISHERIES.

The Sale of Low-quality Manures at Excessive Prices.

The attention of the Board of Agriculture and Fisheries has been drawn to the sale as manures in different parts of the country of substances which are practically worthless as fertilisers, and to the sale of manures of low quality, which are offered at prices far above their real value.

The vendors of these substances generally give in their advertisements and invoices a correct analysis of the constituents, and appear to expect that lack of knowledge on the part of the purchasers will prevent them from appreciating the true value of the substance as indicated by the analysis.

For instance, a manure (1) sold recently at £3 10s. per ton was found on analysis to contain the following constituents :—Nitrogen, 1·8 per cent.; insoluble phosphates, 5·35 per cent. Two other manures sold at £3 15s. and £3 10s. contained respectively the following constituents :—(2) Nitrogen, 1·62 ; insoluble phosphates, 5·4 ; and potash, 0·36 ; (3) nitrogen, 2·51 ; and insoluble phosphates, 1·05.

It may be pointed out that on the basis of the unit values* current at about the time the manures referred to were brought to the notice of the Board, the quantities of nitrogen, phosphates, and potash contained in them could have been purchased in sulphate of ammonia, bone phosphate, and potash salts at the following cost respectively :--

		s.	d.		s.	d.
(1)	Nitrogen 1·8	= 30	10	} =	41	4
	Insol. phosphates 5·35	= 10	6			
(2)	Nitrogen 1·62	= 27	9			
	Insol. phosphates 5·4 ...	= 10	7	} =	45	0
	Potash 0·36	= 6	8			
(3)	Nitrogen 2·51	= 43	0	} =	45	1
	Insol. phophates 1·05...	= 2	1			

The manures would only be worth these prices if manufactured of first-rate materials like sulphate of ammonia, bone phosphate, and potash salts.

Nitrogen, however, may be purchased in cheap forms in organic substances (*see* Leaflet No. 175, *Waste Organic Substances as Manures*), while insoluble phosphates may be purchased in the form of ground rock phosphates at about three-fourths of the sum they cost in steamed bone flour;

* Nitrogen in sulphate of ammonia, 17*s.* 1½*d.* per unit; insoluble phosphates in steamed bone flour, 1*s.* 11½*d.* per unit; and potash, 18*s.* 7½*d.* per unit. For further information reference should be made to Leaflet No. 72 and to the statement of current unit prices published monthly in the *Journal of the Board of Agriculture* during the manure season.

and, assuming the nitrogen in the manures in question to have been derived from a low-grade shoddy and the phosphates from rock phosphates, the manures could have been compounded at the following cost respectively* :—

		s.	*d.*	*s.*	*d.*
(1)	Nitrogen 1·8	= 13	3	= 21	3
	Insol. phosphates 5·35	= 8	0		
(2)	Nitrogen 1·62	= 11	11	= 26	8
	Insol. phosphates 5·4 ...	= 8	1		
	Potash 0·36	= 6	8		
(3)	Nitrogen 2·51	= 18	6	= 20	1
	Insol. phosphates 1·05...	= 1	7		

These figures, it will be seen, vary from 20*s.* 1*d.* to 26*s.* 8*d.* It would indeed be possible to indicate even cheaper materials than those mentioned, from which "manures" having the above composition might be prepared, materials which it would not pay the farmer to apply if he got them for nothing!

The loss to the farmer, however, does not lie merely in the fact that he pays £3 10*s.* or thereabouts for something which at most is only worth 41*s.* to 45*s.*, and may be worth no more than 20*s.* to 27*s.* A much more serious loss arises from the fact that the manurial value of the article is so low that it might be quite ineffective for the purpose in view.

In an action in Scotland, where a farmer purchased a manure, relying on the skill and judgment of the seller, and the manure was found to be not reasonably fit for the purpose for which it was purchased, it was held that the purchaser was not liable to pay the price of the manure, and damages were awarded him for loss due to failure of the crop.

Buyers should not be misled by suggestions that these compound manures have a value which is not indicated by the analysis. For example, it is frequently claimed by the sellers of such manures that the nitrogen they contain is of "animal origin" or "derived from organic matter," and on that account possesses some superior manurial value.† Assertions are also frequently made as to the "large proportion of ammonia" they contain, though it is evident from the analysis given that the content of ammonia is really very low.

A complete explanation of the method of valuing artificial manures so as to ascertain their true commercial value is given in Leaflet No. 72, referred to on page 1, and farmers should consult this leaflet in order to see whether the price of the manure, having regard to cost of carriage and terms of payment, is approximately equal to the value of the

* The unit values being :—Nitrogen in shoddy, 7*s.* 4½*d.* ; phospates in rock phosphates, 1*s.* 6*d.*

† The *commercial* value of nitrogen derived from organic matter may be greater or less than that of nitrogen derived from mineral sources.

fertilising constituents which the manure is stated to contain. When wide discrepancies are disclosed, no purchase should be made ; the chances are that the manure would be dear at any price.

Apart from lime, which may be purchased in normal times at from 10s. to 18s. per ton in most localities, there are three constituents, and only three, which should be taken into consideration in arriving at the value of artificial manures, viz., nitrogen, phosphates, and potash. These are the constituents which an artificial manure is intended to supply to the crop, and any statements as to its value in other directions should be ignored.

Finally, attention must be drawn to the fact that certain proprietary soil insecticides sold primarily for use against wireworms, leather jackets, &c., are advertised in such a way as to suggest that they also have valuable manurial qualities. Claims of this nature should be regarded with the greatest suspicion unless the manufacturers are prepared to state the nature and percentage of the manurial constituents, the value of which may be estimated in the manner described above.

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Leaflet No. 271.

BOARD OF AGRICULTURE AND FISHERIES.

Clover Sickness.

The old idea that clover sickness is due to the exhaustion of some soil constituent essential for the growth of clover, is now disproved, and it has been definitely shown that the disease is of parasitic origin. The present leaflet deals with two distinct parasites which are equally capable of promoting the disease; the one being an "eelworm," *Tylenchus devastatrix*, Kühn,* and the other a fungus called *Sclerotinia trifoliorum*, Eriksson. Another parasite, the Red Clover Gall Gnat, *Amblyspatha ormerodi* nov. sp. Kieffer, also often produces in red clover symptoms similar in appearance to those of plants attacked with the eelworm disease. An account of this Gall Gnat is given in the *Journal of the Board of Agriculture* for June, 1913.

FIG. 1.—CLOVER SICKNESS (*Eelworm Disease*).

* Eelworms affecting other crops are dealt with in Leaflet No. 46 (*Stem Eelworm*), and No. 75 (*Root-knot Disease in Cucumbers and Tomatoes*).

Eelworm Disease.—The earliest symptom of the presence of the eelworm disease is a yellowing and wilting of the leaves of small patches of clover. The patches gradually increase in size as the disease spreads, and may be easily noticed from a distance. Eventually the leaves droop and die, leaving bare and scorched-looking patches in the crop. The above symptoms also exactly describe the general appearance caused by the fungus—*Sclerotinia trifoliorum*—but the true cause of the disease can be readily determined by an examination of a diseased plant. In the case of the eelworm disease, the branches are much swollen and spongy at the point where they spring from the crown (*see* Fig. 1). If a thin slice or section of the swollen portion of the stem be examined under a microscope, numerous eelworms will be seen in the tissues, and eggs are also generally present. The eelworms, as their name implies, resemble an eel in shape, and wriggle and twist about in a lively manner; the eggs are oblong, with rounded ends, and are produced in immense numbers.

This disease is always *due to the presence of eelworms in the soil*, and not to infected clover seed. The ease with which eelworms can be conveyed from one place to another accounts for their presence in new localities. If sheep are feeding on infected clover and afterwards removed to another pasture, their droppings frequently contain eelworms that have in no wise suffered by passing through the alimentary canal, and this is more especially true of the eggs, which are also capable of resisting desiccation for a long period without injury. Eelworms thus conveyed continue to live and increase in the soil, as they are not restricted for their food to clover alone, but can also attack many wild plants, and several kinds of cultivated plants, including oats; the latter become swollen near the base, showing the disease known as "segging" or "tulip-root." Eelworms may also be distributed in the soil adhering to cart wheels, tools, &c.

Sulphate of potash is the most effective remedy, applied at the rate of 4 cwt. per acre. When a crop shows signs of the disease, this remedy should be applied at once to the diseased patches, taking care to extend the dressing beyond the obviously diseased zone. This method will not cure diseased plants, but only prevent the spread of the disease by killing eelworms migrating from one plant to another. As this substance will not destroy the eggs it will be necessary to apply more than one dressing in order to kill the eelworms as they hatch out.

Deep ploughing is also beneficial, when conditions will allow, as it has been proved that when eelworms are buried at a depth of five inches they are killed.

Infection of the clover plant by eelworms can only occur during the seedling or quite young condition, hence sulphate of potash should be applied to the land shortly before the *seed is sown, so that it may be in full activity when the clover crop is quite young.*

FIG. 2.—CLOVER SICKNESS (*Sclerotinia Disease*).

1.—Root of Clover plant with sclerotia : nat. size.
2.—A sclerotium producing fruit : mag.
3.—An ascus, containing eight spores : highly mag.

Sclerotinia Disease.—As previously stated, the manifestations of the presence of this parasite in a clover crop are identical with those indicating the presence of eelworm. The evidence that a plant is attacked by the fungus *Sclerotinia* is the presence of one or more black, wart-like bodies attached to the root and collar. These black bodies are known as sclerotia, and consist of a compact mass of fungus spawn or mycelium, produced at the surface of the root from mycelium previously present in the tissues of the plant. When diseased plants are dead, the sclerotia remain free in the soil, and eventually produce spores, which infect future crops.

It is practically impossible to kill sclerotia present in the land, but as the parasite, so far as is known, can only attack clover, lucerne, and other leguminous plants which occur as weeds, land known to be infected should be kept free from all leguminous plants for some years. It is only by starving the fungus, through the destruction of its host plants, that the land can be freed from the disease.

Whitehall Place, London, S.W.,
August, 1913.

Leaflet No. 272.

BOARD OF AGRICULTURE AND FISHERIES.

Supply of Store Cattle and Slaughter of Young Calves.

The attention of the Board has been called to the dearness and apparent scarcity of store cattle, and to the fact that in spite of this a large proportion of the calves born in Great Britain each year are slaughtered while quite young.*

The two main facts—the rise in the price of store cattle and the extent to which young calves are slaughtered—are matters of common knowledge. The annual statistics published by the Board show that in the period from 1905 to 1912 the average price of stores has, with few breaks, risen considerably. Exact figures showing the number of calves slaughtered each year are not available, but there is no doubt that, leaving out of account purely dairy breeds, such as Ayrshires and Jerseys, which could not, as a rule, be profitably reared for beef production, the proportion slaughtered to the number reared is very considerable.

It is sometimes suggested that the rise in the price of stores is due to an actual falling off in the supply; this, however, is clearly not the case, for, leaving out of consideration the abnormal years 1911 and 1912, the number of store cattle imported from Ireland has on the whole been fairly maintained in the last few years; while the number of cattle in Great Britain, other than cows or heifers in calf or in milk, has not declined. A comparison of the fluctuations in the prices of both store and fat cattle suggests a more probable explanation of the rise in prices. As is shown by the following figures, and as was pointed out in Part III. of the Agricultural Statistics for 1910, the two classes move on the whole together, the rise in the price of store cattle during the last few years being almost exactly in proportion to the rise in the value of fat stock:—

	Average for England. Fat Cattle (1st Quality Shorthorn Type) per 14 lb. stone.			Average for Gt. Britain. Stores (1st Quality Shorthorn Type, Two-year-olds) per head.		
	£	*s.*	*d.*	£	*s.*	*d.*
1905	0	7	7	13	5	0
1906	0	7	6	13	0	0
1907	0	7	10	14	1	0
1908	0	7	11	14	10	0
1909	0	8	2	14	7	0
1910	0	8	7	14	16	0
1911	0	8	2	14	4	0
1912	0	9	0	15	7	0

* *See* Journal of the Board of Agriculture for August, 1911, and article in the Journal for April, 1912

The figures quoted show that the rearer of store cattle has obtained at least a fair share of the rise in the price of beef; feeders and graziers will perhaps say more than a fair share in view of the rise in the price of feeding stuffs, the cost of which affects the fattener much more than it does the rearer. In any case there can be no doubt that the rearing of cattle has paid better during recent years than for some time previously.

At first sight, it seems remarkable that the increase in price has not apparently resulted in a corresponding increase in the supply. The question, however, is not a simple one of supply and demand, but is complicated by the fact that in this country the farms on which the cattle industry is carried on are, to a great extent, sharply divided into three classes: (1) dairy farms, on which the majority of the calves are bred, but where few are reared; (2) rearing farms, on which calves—both home-bred and purchased—are reared, but not fattened; (3) fattening farms, where purchased store cattle are fattened. There are, of course, many cases where calves are bred, reared, and fattened on the same farm, but the three classes are nevertheless well marked, as is shown by the very small proportion of calves reared in the principal dairying districts, and by the large number of store cattle appearing in our markets every year.*

To a great extent this segregation is unavoidable; dairy farmers can spare neither milk for calves, nor land for grazing young stock; rearing is, as a rule, pursued on farms having a quantity of cheap grass land, which is not considered good enough for fattening; where fattening is pursued the best grass is generally believed to be most profitably devoted to that purpose; while on arable farms cattle often cannot be economically kept at all in summer owing to the absence of pasturage and to the requirements of sheep. Still, while this general division is to a great extent necessitated by natural conditions, and to some extent preserved by existing housing arrangements, it is possible that the specialisation is in many cases unnecessary or carried too far; and there is little doubt that there are large numbers of farmers, who at present rely almost entirely on purchased stores, who might with considerable advantage to themselves rear at least a fair proportion of the cattle they require every year. Of course, such a change in farming practice might involve some re-modelling or adaptation of the farm premises. While it is impossible to bring actual figures to prove the contention, there is every reason to believe that under present conditions the rearing of calves may be sufficiently profitable, provided that the business is well understood and properly conducted, and, above all, that the right class of calf is obtained at the outset.

* See *Agricultural Statistics*, Part III. 1911 (p. 204).

This brings us to the crux of the whole question. In order to attain success in rearing, it is essential to obtain the right kind of calf, and it cannot be too strongly urged that anyone taking up calf rearing should be careful to secure a regular supply of calves of the right breeding. With ill-bred calves, the whole trouble and expense involved in rearing may be utterly thrown away. At the present time, even in the dairying districts of Cheshire and the North of England, where a good class of Shorthorn cow predominates, many calves of a decidedly poor type are bred owing to the use of inferior bulls. Generally, rearers realise that such calves are really not worth buying, and they have to be sold in large numbers every spring for a few shillings a head for immediate slaughter, when perhaps not more than a day or two old.* On the other hand, it is usually the case that even when there is a glut of calves at any particular market, animals known to be well-bred are always easily sold, and as a rule the demand for such is much greater than the supply.

Another obstacle in the way of the extension of rearing is the fact that the farms adapted for the business are very often at considerable distances from the dairying districts, the result being that while the dairy farmer finds it difficult to get rid of many of his calves, the rearer finds it equally difficult to secure calves, and in some districts a newly-born calf, of good type, cannot be obtained for much less than £3.

Sufficient has been said to show that the problem is by no means a simple one, but the carrying out of the following suggestions would help to solve it, and at the same time prove of advantage to all concerned :—

1. Dairy farmers keeping good general purpose cows, such as Shorthorns, Lincoln Reds, Red Polls, and South Devons, could in most cases rely on a steady demand at satisfactory prices for their calves if they used better bulls than are employed in many cases at present. Formerly, when breeders of pedigree stock paid little attention to milk production, there was some danger of losing milk through the use of really well-bred bulls, but now that so many breeders of dual-purpose cattle keep milk records and use as sires in their herds only bulls of a good milking strain, there is much less excuse for the use of bulls of nondescript breeding. A dairy farmer who rears heifer calves naturally has to attach prime importance to milk, but this is much more likely to be secured by using a bull of which the dam, grandams, and great grandams are known to have been good milkers,

* Apart from the agricultural aspect of the case, the Board are advised that the use of the meat of immature animals for human consumption is objectionable on grounds of public health. It is the practice in the City of London to condemn carcasses of calves which weigh less than 48 lb. or are less than three weeks old. The Netherlands Government has prohibited the export to the United Kingdom of calves which weigh less than 21½ kilos (*i.e.* about 48 lb.) without head, skin and intestines.

than by the use of an animal of which the known breeding goes back perhaps no farther than dam and sire. There are, however, many dairy farmers who keep a bull merely to maintain the flow of milk of their cows without any intention of rearing calves at all. In such a case there could be no objection to using a good bull of a purely beef type; and if, as suggested later, they made arrangements to supply calves direct to a group of rearers, the enhanced cost of securing a good animal would be well repaid by the better price obtained for the calves. Even where heifer calves are to be kept, it is seldom that the breeder intends to rear calves from more than a few of his best cows, and it is worth considering whether a bull of the beef type could not be used for the others. There would be little difficulty in carrying out such a suggestion, if some system of co-operation were devised whereby each man would have the use of two or more bulls. In order to inspire confidence in the minds of purchasers at a distance, it would be advisable to select for the two purposes bulls of which the progeny would be easily distinguished, *e.g.*, in a Shorthorn herd an Aberdeen-Angus bull, of which the calves would practically all be black and polled, might be selected to produce calves for rearing purposes.

2. The question of transport must be considered, though it is not easily solved. A great many calves are bred in districts where there is no demand for them, and the farms where they are wanted may be anything up to two or three hundred miles away. The calves, when perhaps only a day or two old, have therefore to undergo a long railway journey in addition to the exposure in the market (though by making arrangements beforehand the latter could and ought to be avoided). Apart from the cold and discomfort, which alone in most cases would not be serious, there is bound to be a fairly long fast. In the case of a long journey, the railway companies are required to feed the calves, but it is not easy to provide suitable warm milk at short notice, and the men set to feed the calves—which may not have learned to drink—have no interest in them. This, along with the sudden and often violent change of food, tends to induce scour and other troubles, and it is not surprising that such calves often receive a serious check from which they recover very slowly, if at all. The difficulty would, however, be greatly lessened if the calves were kept for a couple of weeks before being sent away, as they would then have gained strength and learned to drink. At present, dairymen are often unwilling to keep their calves simply because they are almost as difficult to sell at two weeks as they are at two days old.

Given good calves, there is, however, generally a demand, and in many cases there would be little difficulty in the way of keeping them until they are in a fit condition for

travelling. In the spring, when the majority of the calves are arriving, there is often a glut of milk, and on cheese-making farms there is usually available for some little time from newly-calved cows a considerable quantity of milk, which is not fit for cheese-making.

Still more could be done by proper treatment of the calves when they reach their destination. After a lengthy journey the animals are usually thirsty, and the natural tendency is to give a good meal at once. This is a great mistake, and is, perhaps more than anything else, responsible for the scour to which purchased calves are so subject. The methods adopted by successful rearers vary a good deal; one of the best is to give a small dose of castor oil and some stimulant in a little warm milk, as soon as the calf arrives, and after an hour or so to give a small meal of milk, which should not be too rich. For the first few days the calf should continue to receive very small quantities of food at a time, though it should be fed as frequently as possible, and at least four times a day. If the least sign of scour* appears, a dose of castor oil should be administered at once, the quantity of food reduced by one-half, and a little chalk given. (It is a good plan to leave a lump of chalk in the calf house, so that the calves can lick it as they like.)

Incidentally it may be said that most cases of scour are caused by insufficiently frequent feeding or by irregularity in the quantity and quality of the food supplied. This explains the well-known fact that a small farmer, whose wife or family looks after the calves, is usually far more successful in rearing than a large farmer who leaves them largely to the management of more or less careless hired labourers. *If dealt with at once*, scour can usually be easily cured by the method suggested above. The common plan of administering astringent materials is wrong in principle, and cannot effect a permanent cure. The real cause of ordinary scour is indigestion, the scour being simply an attempt on the part of the calf's digestive system to get rid of material of which it cannot make use, and the rational system of treatment is to help the calf to clear this out. No treatment, however, will be satisfactory if the calf is allowed to become really ill before it is applied. In such a case the animal usually thrives badly afterwards even if it makes some sort of recovery at the time.

3. There remains the problem of providing some means for bringing the breeder of good calves and the would-be rearer into direct touch with one another in cases where they are in different parts of the country. The plan of selling young calves in markets and auctions, with the consequent

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* The scour referred to in this article is the ordinary scour and not white scour. The latter is a special affection of bacterial origin, and unfortunately appears under the best *régime*.

exposure and delay in transport, is responsible for many of the unsatisfactory features of the question at the present time, and must be strongly deprecated. As a rule, individual rearers want only a few calves at a time, and are unable to guarantee a market for more than a small proportion of the calves a dairy farmer has to sell, but rearers might combine, and after inspection of the cows and arranging terms and safeguards, agree to take the whole of the available calves from a dairy farmer or from a group of dairy farmers, in which case there are few who would not be perfectly willing to let the rearers have a voice in the selection of a bull for at least some of the cows, to give some kind of guarantee that none but calves of the approved breeding will be sent, and to undertake that the calves will be forwarded in such a way as to reach their destination with as little discomfort and injury as possible.

This is a problem well worthy of the attention of farmers, clubs and associations, and if any such feel disposed to go into the question, the Board would be pleased to advise as to what other societies it might be desirable to approach, and to do all they can to facilitate attempts to get into direct communication.

There are other problems, *e.g.*, the fact that the majority of the calves are dropped in the spring, whereas the rearer would prefer a more equable distribution or even to have the majority in winter; the difficulty encountered by the large farmer in finding someone to look after the calves properly; and the occurrence of such diseases as husk and black quarter in calves and of contagious abortion in cows; but the really essential points of the question are those to which attention has been directed above.

Whitehall Place, London, S.W.,
July, 1913.

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Leaflet No. 273.

BOARD OF AGRICULTURE AND FISHERIES.

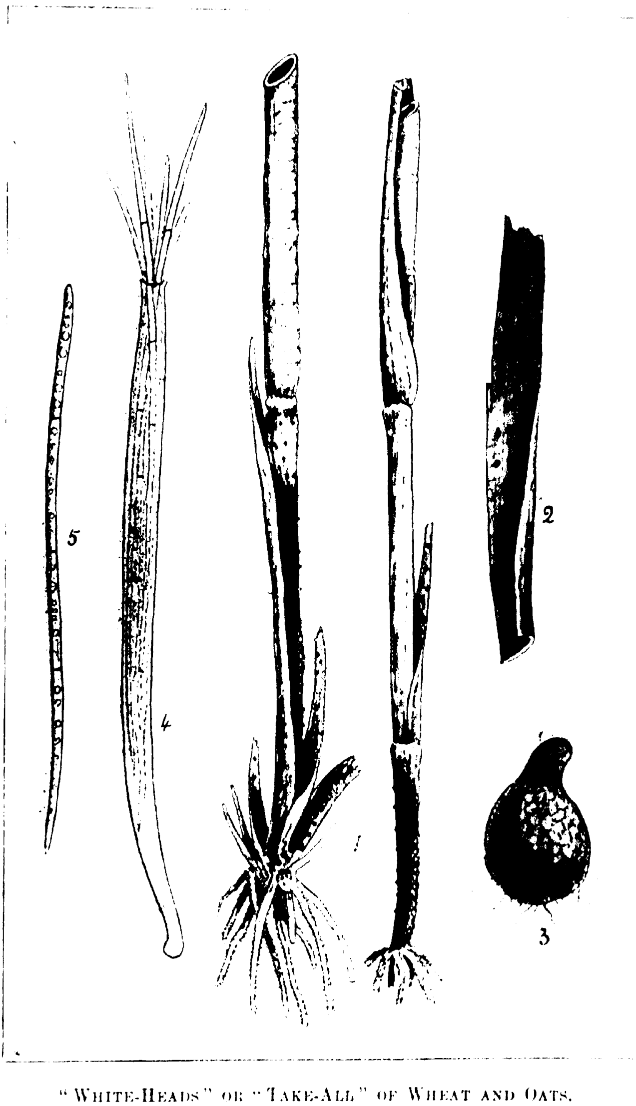
"White-Heads" or "Take-All" of Wheat and Oats (*Ophiobolus graminis*, Sacc.).

Description of the Disease.—This serious disease presents itself under two very different aspects, depending to a very great extent on the period at which the plants are attacked, and on weather conditions favouring respectively the host plant or the fungus.

In the condition known as "White-heads," the plants usually attain their full growth and the ears are of normal size, but the grain either remains undeveloped, or is very much shrivelled and useless. The ears and straw of such diseased plants present a bleached appearance, suggesting at a distance premature ripening, but on examination the entire plant proves to be dry and dead, and two or three inches at the base of the straw presents a blackened appearance, as if it had been charred. This phase of the disease often occurs in more or less definite patches in the field, which show conspicuously at a distance owing to their whitish or bleached appearance, while the healthy part of the crop is still green.

During the winter if the blackened straw, left as stubble, be examined with a pocket lens, numerous minute, black, wart-like bodies will be seen, more especially on the inner side of the sheaths encircling the base of the stem. These are the fruits of the fungus causing the disease.

In the condition known as "Take-all," the plants are attacked seriously at an early stage of growth and become yellow, and often die before the stem is formed, or at all events before the ear escapes from its sheath. As in the case of "White-heads" the disease spreads from a centre, and frequently considerable patches of such stunted plants may be found. If carefully examined, the base of the plant will be found to present a somewhat blackened appearance. The roots of diseased plants are always very woolly, owing to a dense formation of root-hairs. In many instances a second lot of roots may be formed higher up on the stem of diseased plants, but these in turn are attacked by the fungus, and the plant ultimately succumbs. "White-heads" and "Take-all" were at one time considered as two independent diseases, caused by different organisms, but McAlpine has proved that the two are caused by a fungus called *Ophiobolus graminis*, Sacc., which is always present at the base of the stem. It is readily recognised by the dark colour of its mycelium, which forms a thin felt on the stem and leaf-sheaths. Infection experiments have proved that this fungus is the direct cause of the disease.



"WHITE-HEADS" OR "TAKE-ALL" OF WHEAT AND OATS.

Fig. 1.—The appearance of the fungus at the base of oat plants. Nat. size. Fig. 2.—Fungus on a leaf-sheath. Slightly mag. Fig. 3.—Perithecium, or fruit of the fungus. Mag. Fig. 4.—Ascus with spores escaping. Mag. Fig. 5.—Spore. Mag.

Prevalence of the Disease.—The disease is probably far more prevalent in this country than is generally suspected. It is stated that the loss occasioned ranges from one-half to one-fiftieth of the crop. The disease is also well known in Italy, France, Germany, Belgium, Australia, and the United States, and is in all probability present wherever wheat is cultivated.

The reason why uncertainty as to the cause of the disease has existed so long is due to the fact that the fungus generally produces its fruit during the winter months on the stubble, and hence has escaped observation; for during the period of growth of the wheat the mycelium only of the fungus is present.

Method of Attack.—The spores of the fungus are liberated during the winter or early spring, and remain in the soil until the required amount of moisture and temperature induces germination. According to Mangin,* the spores on germination either directly give origin to a number of colourless, minute, sickle-shaped, secondary spores, or a slender germ-tube is first formed, which bears a cluster of the secondary spores at its tip. From these secondary spores on germination a very delicate germ-tube arises, which enters the wheat plant through the root-hairs. Mangin observed that when 1 per cent. of sulphate of ammonia, or 1 per cent. of phosphate of ammonia was added to the water in which the spores were placed, germination was arrested. After the mycelium has entered the root it gradually extends for three or four inches up the stem, and also passes into the sheaths surrounding the base of the stem. In addition to permeating the tissues, the mycelium also develops on the surface of the stem, and on the inner surface of the sheaths, where it assumes a dark brown colour, and forms a somewhat thick felt that can be scraped off. The minute black fruits may be found nestling in this felt of mycelium; they also occur on the root.

According to McAlpine,† wheat is the only cereal attacked by this fungus in Australia; "the oat grows well in Take-all patches, and is not attacked by the fungus, hence it is recommended for starving it out." This statement, however, does not hold good for this country, as specimens of oat plants attacked by *Ophiobolus graminis* were sent to Kew from Corwen, N. Wales, for determination during 1912. The diseased oats showed the "White-head" phase, with silvery, empty glumes, and the base of the stem and root with a copious development of blackish, superficial mycelium. The fruit of the fungus was present, setting aside all doubt as to the identity of the parasite. The crop in this instance was seriously affected, the diseased plants occurring in

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* *Compt. rend.*, 127, p. 286; *Bull. Soc. Myc. France*, 15, p. 210.

† *Journ. Dept. Agric. Victoria*, 2, p. 424.

scattered patches. A field of wheat near Shere, in Surrey, was also badly attacked by the "White-heads" condition of this disease.

Methods of Prevention.—Land that has grown a diseased crop is certain to be infected, owing to the fact that the fungus is confined to the base of the stem, which is left on the land as stubble and ploughed in. As both the spores and the vegetative mycelium are capable of infecting cereals, prompt preventive measures should be applied without fail. From what has been stated, 1 per cent. of superphosphate of lime, 1 per cent. of sulphate of ammonia, and 1 per cent. of phosphate of ammonia are respectively capable of arresting the growth of the mycelium of the fungus, hence the choice of the particular fungicide resolves itself into questions as to the relative cost of each of the three substances, and also as to which of the three would be most suitable in addition as a fertiliser for a cereal crop. Superphosphate of lime has been definitely proved at Kew to arrest the growth of the fungus, and this material can therefore be recommended, the quantity required being 1½ cwt. per acre. It is important that the dressing should be applied when the crop is young, as it is during this period that it is most liable to infection. Sulphate of iron has proved effective in Australia, in checking the ravages of "Take-all," 1 cwt. per acre being applied.

The earlier varieties of wheat are said to be most susceptible to the disease, and red wheats, broadly speaking, are least so, but they are not immune.

The fungus also attacks wild grasses, Couch grass (*Agropyrum repens*, Beauv.), *Bromus sterilis*, &c., hence headlands, &c., should be kept clean.

"Blindness," or abortion of the grain in the ear, may be due to other agents than *Ophiobolus graminis*. Much shrivelling of the grain and bleaching or silvering of the inflorescence in cereals and wild grasses is due to the activity of *Thrips cerealium*, Halid., a very minute insect. *Helminthosporium gramineum*, Eriks., the cause of barley leaf-stripe,* also sometimes arrests the development of the grain. In both instances, the absence of blackness at the base of the stem will clearly indicate that *Ophiobolus* is not the cause of injury.

* *See* Leaflet No. 159.

Whitehall Place, London, S.W.,
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Leaflet No. 274.

BOARD OF AGRICULTURE AND FISHERIES.

PARASITIC MANGE IN HORSES, ASSES, AND MULES.*

Definition.

Parasitic Mange is the name given to a condition of the skin caused by parasites, known as mites or acari, which belong to the family *Acaridæ.* It is a contagious disease, since the parasites may be conveyed to other equine animals.

The Parasites.

The mange mites are exceedingly small, round or oval in shape, and usually only visible through a hand lens or microscope. There are several distinct stages in their development; the newly-hatched mites (larvæ) have three pairs of legs, but after further development they acquire a fourth pair. The legs are furnished with bristles, claws, and some with suckers. From the head project the feeding organs, and the jaws resemble saws. The body is furnished with scales, spines, and bristles. The adult females lay eggs, which hatch out into larvæ in from four to seven days. These larvæ, after successive moultings, develop into adults. The mites can exist on moist dung for several weeks, but live for a shorter time on a dry surface. The eggs are said to retain their vitality for several weeks if moisture is present, but in a dry atmosphere only for from three to six days. The mites are killed in a short period if exposed to a temperature of 104° F. or over, but moderate warmth, such as obtains in warm stables and during summer, stimulates them and renders them more active.

Forms of Mange.

Three varieties of parasitic mange affect horses, asses, and mules, viz.:—(1) Sarcoptic, (2) Psoroptic, (3) Symbiotic. Each is caused by a special mite which has a somewhat different mode of life.

The *Sarcoptic* form spreads slowly, but is the most serious on account of its being the most difficult to cure. The mites, known as the *Sarcoptes*, bore their way through the outer skin, burrow underneath it, and cause irritation to

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**See also* Leaflets No. 61 *(Sheep Scab)* and No. 135 *(Mange in Cattle)*.

the animal, setting up inflammation of the skin. In the small galleries or tunnels thus formed the mites lay their eggs. It is on account of this burrowing habit that it is difficult to reach the parasites with destructive agents. The mites may attack any part of the body, but they usually locate themselves first about those parts which come in contact with the saddle or other harness, from which they may spread to other parts. The Sarcoptic form of mange is analogous to the itch or scabies of man.

The *Psoroptic* form generally spreads more rapidly over the body. It is more prevalent than the Sarcoptic form. At first it is usually confined to those parts situated near the long hair of the body, such as the neck, withers, rump, and base of tail, but in advanced or neglected cases the parasites may spread all over the body, and may be found on the buttocks and inside the thighs. The mites, which are known as *Psoroptes*, live on the outer surface of the skin, and cling to it by means of their mouths and limbs. They bite the skin to obtain food, causing irritation and inflammation. Over the injured parts scabs are formed and scurf accumulates, amongst which the mites shelter, feed, and breed. The scab increases in size as the mites increase in number, and each new generation of young parasites selects fresh feeding ground, usually around the edge of the older scab, or the mites may, through the grooming, be disturbed and distributed, setting up additional centres of disease on other parts of the skin.

The *Symbiotic* form is probably the most prevalent, but it is not so serious as the two former. It is usually confined to the extremities of the legs, but may also affect the tail. It develops slowly, and only exceptionally invades other parts of the body.

An animal may harbour more than one form of mange at the same time.

Symptoms.

Mange may not always be detected until it has made considerable progress, or the early symptoms may not have been regarded as important by the owner or the attendants.

The first indications are that the animal is restless, appears to be itchy, is incessantly rubbing against any objects within reach, including the pole or shafts of the cart, or against other horses. Affected animals will even bite and gnaw the parts attacked by the parasites, scratch the parts with the hind limbs if accessible, and stand rubbing one leg against the other. They may be seen or heard scraping, pawing, kicking, or stamping the feet a good deal, especially during the night in a warm stable. There may also be switching and rubbing of the tail. When the scabby parts are touched

with the hand or passed over with the grooming tools, the animal will lean towards the attendant and manifest a sense of pleasure, which is frequently accompanied by a nibbling movement of the lips. The hair over the affected parts bristles or stands erect, and in more advanced cases is twisted or broken off short. Bare patches of skin are seen, due to the hair falling out or having been pulled or rubbed out. The skin may show an inflamed, pimply surface, with some long or broken hairs still in place, or the part may be quite bare and scurfy. The parasites cause pimples to appear on the skin wherever they bite. Yellowish lymph exudes from the pimples, and helps to form small scabs. This lymph may mat the scabs and hairs together into a hard mass, which may be partly or entirely rubbed off, leaving an excoriated surface. On the hairless parts red scabby spots may be seen, which readily bleed, and there may be patches of scab containing blood adhering to the skin. In advanced, neglected, and bad cases, the skin loses its elasticity, becomes dry and hard, and is wrinkled or corrugated into folds. Finally, the scabby skin may crack, forming deep fissures. These may bleed and leave nasty, unhealthy-looking sores, which in turn may fester or suppurate. There is also an offensively smelling discharge in many cases. If the disease is allowed to proceed unchecked the animal speedily loses condition and becomes emaciated, gets no rest from the incessant irritation, has a very dejected and repulsive appearance, becomes weaker and weaker, and may even die in a state of exhaustion.

In the Symbiotic form of mange a horse may do serious injury to its limbs, particularly to the coronet, by bruising it with the opposite foot in making attempts to relieve the itchiness.

Methods of Spread.

Parasitic Mange can only be produced by one or other of the previously mentioned mites breeding and multiplying on the animal's skin. A single fertilised egg-bearing female is sufficient to start a case of mange, which in turn may spread to many other animals. All cases of mange can be traced to contagion from an existing or pre-existing case. The parasites can be spread directly from one animal to another, or indirectly through the medium of litter, rugs, bandages, grooming tools, saddles, harness, mangers, stable stalls, loose boxes, stablemen and their clothing, and stable utensils. The parasites may be picked up by an animal at an hostelry, on board ship, at sales and fairs, in horse-boxes or railway trucks, at grass, by loan or exchange of harness or by the use of second-hand harness, and from shafts of carts.

In fact, anything that has been in contact with a mangy animal, and which has not been subsequently disinfected, may be a vehicle of infection. Given infection, there are certain conditions which, in some animals, at least, appear to be more favourable to the development and spread of the disease; such are low condition and want of grooming. The parasites may live off the animal for some weeks in harness, clothing, litter, &c., and may therefore be capable of infecting another animal, or even re-infecting the same animal at a future date.

Treatment.

Mange is not primarily a disease, but a condition of the skin resulting from the presence and action of the parasites or mites, which obtain their nourishment by piercing the skin. The treatment must be directed to the destruction of the parasites and their eggs, and it is possible to use effective local remedies in the form of skin dressings, which will not only destroy the mites without causing further injury to the inflamed and irritated areas, but will act beneficially by allaying the irritation. The treatment is essentially an external one, but plenty of good food should be given, and if the animal's condition has been reduced or the health materially impaired, tonic medicine given internally may be beneficial. Usually, however, recovery is effected without internal treatment.

Prevention.

All newly-purchased animals should be carefully examined for suspicious areas on the skin, and if such are present the animals should be isolated and kept under observation until expert advice can be obtained, but those in charge must not forget that mange caused by Sarcoptes or Psoroptes in equine animals is a notifiable disease. Care should be taken not to use second-hand or borrowed harness, clothing, grooming and stable utensils which have not been thoroughly cleansed and disinfected. Owners should be particular about the livery stables which their horses frequent, and litter which has been used for other animals should be regarded with suspicion.

In addition to the isolation and treatment of an animal actually affected with mange, particular attention must be paid to cleansing and disinfecting the stable, litter, harness, and all articles that have been used about the patient. The premises and articles to be included in the disinfection must be reckoned from a time prior to the recognition of the disease.

The Parasitic Mange Order of 1911.

Parasitic mange in horses, asses, and mules is the subject of administrative action in Great Britain, and an Order (the Parasitic Mange Order of 1911) has been issued by the Board of Agriculture and Fisheries, under the Diseases of Animals Acts, which is enforced by the Local Authority. This Order applies only to two forms of mange, viz., the Sarcoptic and the Psoroptic forms. The Order makes it compulsory for every person having in his possession or under his charge a horse, ass, or mule affected with or suspected of Parasitic Mange to give notice at once to a constable of the police force for the area wherein the animal is, and also to keep the animal, as far as practicable, separate from other equine animals not affected. In the administrative county of London (including the city of London) the notice may be given to an Inspector of the Local Authority. Every veterinary surgeon who meets with a case of Parasitic Mange in his practice is required to give notice of it to an Inspector of the Local Authority. The Local Authority is required to make the necessary examination with the assistance of a Veterinary Inspector, who, if satisfied as to the existence of disease, may serve a notice on the occupier of the premises requiring the detention and suitable treatment of the affected animal and the other animals on the premises. The Order also provides for the proper cleansing and disinfection, by the occupier, of the premises, harness, stable utensils, grooming tools, or other things used about a mangy animal. The Order makes it unlawful for any person to expose an affected animal in any market, fair, or sale-yard, or in a market lair; to send an affected animal by rail or vessel; to take such an animal along a highway without the written authority of an Inspector; or to place such an animal or allow it to stray on common or unenclosed land, or a field or other place insufficiently fenced. Any contravention of the provisions of the Order renders the person or persons concerned liable on conviction to a fine of £20.

Copies of the Order can be obtained from the Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

Whitehall Place, London, S.W.,
July, 1913.

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Leaflet No. 275.

BOARD OF AGRICULTURE AND FISHERIES.

Improvement of Poor Hill Pasture.

At the present time there are few agricultural problems of more importance than that of the improvement of poor hill pasture, which forms a large proportion of the total area of this country. Within recent years a great deal of attention has been paid to the improvement of poor lowland pasture, and competent men can now suggest methods of improvement which are usually successful and profitable.*

In the case of hill pasture methods of improvement can only be suggested, as a rule, in a very tentative way, and then often with the risk that they may be unprofitable. The question is complicated by the facts that (1) the cost of improvement may be relatively great, owing to the inaccessibility of the grazing; (2) in some cases climatic conditions restrict not only the growth of herbage, but also the grazing season; (3) there are many distinct types of herbage—or modes of growth of the same herbage—dependent on soil, climate, and general conditions.

In some cases the first cost of improvement compared with its prospective value renders treatment very doubtful under present economic conditions. At the same time, there are large areas of fairly accessible poor hill pasture, mostly under one thousand feet above sea-level, which are not productive either to the extent that climatic and general conditions justify one in expecting, or to the extent that they used to be within quite recent times. At one time a considerable proportion of such land was cultivated, and in most cases it has only gone completely out of cultivation within the last fifty years or so. Since the time when the old method of treatment, draining and liming, became too expensive, little attention has been paid to the improvement of land of this kind. It is hoped, therefore, that a brief consideration of a few points on which information is available may be helpful, and stimulate further inquiry.

In considering the question of improvement, manurial treatment at once suggests itself. There are, however, other problems which in many cases are even more important than manuring, and a few of these may be mentioned first.

* *See* "Influence on the Production of Mutton of Manures applied to Pasture," *Supplement to Journal of the Board of Agriculture*, Jan., 1911, price 4*d*., post free, and Special Leaflet No. 51 (*Manuring of Grass Land*).

Effect of Grazing only with Sheep.—There is little doubt that continuous grazing with sheep alone will ultimately reduce the quality of almost any pasture. In the case of many Down pastures, where the practice prevails of using the Down as an outrun during the day and the lower arable land for folding at night, it is evident that fertility has fallen to a very low ebb. The habit of sheep in closely grazing only the finest plants and in leaving the coarse plants untouched, results sooner or later in the disappearance or suppression of the former and the preponderance of coarse, inferior grasses. This effect is intensified by the fact that, if sheep are to be kept on the same ground year after year, overstocking must at all costs be avoided if a healthy flock is to be maintained; consequently good pasture may never be really closely grazed except perhaps at a few favoured spots.

In many cases it would pay well to mix a few cattle with the sheep on *rough* hill pasture, even though the cattle gave no return themselves for their grazing, which would seldom be the case. Provided a suitable system of manuring is adopted (*see* page 5) Down pasture which has been grazed continuously by sheep for many years will also be greatly improved by the introduction of cattle. It is generally thought that many hill grazings in Scotland date their degeneracy from the clearance of the Highland cattle to make way for sheep, and perhaps it is not too much to say that in all pastures, whether hill or lowland, proper grazing is at least as important as manure.

Fencing of Downland.—While the enclosure of Down land by fencing is not an absolutely necessary preliminary to its improvement, it may at least be said that the full benefits will not be secured while the land is unenclosed. Apart altogether from its bearings on manurial treatment, the fencing of a Down on which a breeding flock of 400 to 500 sheep is pastured at once frees a man and boy for other useful work during a large part of their time. Moreover it obviates the necessity for shutting up the sheep nightly in a fold, and allows them to graze late and early, as sheep instinctively do, to their great advantage.

Presumably it is the initial expense that deters farmers from more generally fencing their Downs, and yet this need not be so great as is usually supposed if farmers would arrange for the erection of the fencing when other work is not pressing and supervise the details carefully. To take the average case of a Down 1,600 yds. long and 800 yds. wide; this means an area of 264 acres, and necessitates 4,800 yds. of boundary fencing. In normal times a light, but efficient, post and wire fence, with a reasonable supply of gates, can be erected for 4½*d.* per yd., or for a total cost of £90; and for another £15 a transverse fence can be erected dividing the area into two fields of 132 acres each. This

works out at a capital expenditure of about 8s. per acre. The wire, if solid and galvanised, will last for a great many years, but even assuming that the whole fence has a life of only 10 years, it means a sinking fund at 4 per cent. of only 8*d.* per acre per annum, or £8 16*s.* per annum in all, an expenditure that will never fail to be well repaid.

If, instead of costing 4½*d.* per yd., the fence, with the necessary gates, cost 6*d.* per yard, the total expenditure for the two fields would be £140, or about 10*s.* 6*d.* per acre, necessitating a sinking fund to redeem in 10 years of 10½*d.* per acre per annum, or a total charge of less than £12 per annum. Needless to say, if farmers whose land adjoined agreed to fence, the cost of the boundary fences would be shared, and the individual outlay correspondingly reduced. Detailed particulars as to the erection of a suitable fence are given in an article which appeared in the *Journal of the Board of Agriculture* for November, 1915.

Bracken in Pasture.—Many pastures owe their inferiority to the presence of bracken, which in some cases has obtained such a strong hold on the ground that the pasture, as such, is worthless. A satisfactory method of eradicating bracken is to switch off the shoots, at the stage when they are most readily broken, with a piece of fencing wire twisted on at the end of a stick. A number of boys under proper supervision could be employed for the purpose. The bracken should be gone over twice a year and in 3 years it will have largely disappeared. If for any reason early cutting has been omitted, the operation should be postponed till about midsummer when maximum growth will have been reached. In this case a supply of useful bedding may be secured. Experiments in North Wales have shewn that at this stage the plant is very vulnerable, as the underground stems are practically exhausted of food material and storage for future growth has not yet begun. At this stage of growth the scythe must be used. If the surface of the ground permits, the young fronds of the bracken can be readily broken off by chain harrowing. The cost of treatment is not excessive when it is remembered that the improvement, with a little care and attention in future, will be permanent.

Encroachment of Heather.—On poor, dry soils, containing little or no lime, in a moderately dry climate, heather is almost certain sooner or later to creep into a pasture, and if not checked will cause serious deterioration, even though it has a certain value itself as food for sheep. Apparently little has been done to determine the best means of replacing heather by grass, *i.e.*, short of ploughing up, or of stocking more heavily than is practicable in most cases. Very often when the heather has been eradicated, either accidentally or intentionally, it has only been replaced by

bracken, an equally obnoxious weed. Generally, slow and thorough burning in large areas (so as to minimise the risk of re-seeding of the burnt ground from old heather), followed by applications on dry soils of lime and superphosphate, and kainit when available, or of basic slag with or without kainit on wetter ground, would seem the most hopeful method. As in the case of bracken, heather rarely if ever appears on soils containing a fair proportion of lime. Occasionally it is found in fairly extensive tracts in limestone districts, but in such cases close investigation will reveal the fact that the surface soil contains little lime in spite of its overlying calcareous rock.

Gorse, Furze, or Whin.—This plant often covers wide areas of down land and hill pasture. Stubbing or digging up is out of the question on the score of expense. Burning in winter or spring does nothing to eradicate the pest, which shoots from the stumps more densely than before. The best plan is to burn slowly against the wind in the latter half of July, when a large proportion of the plants will be entirely destroyed. When available at a reasonable price, wild white clover may be sown on the bare patches, which it will speedily cover with nutritious herbage. The seed might be sown at the rate of about 1 lb. per acre. If sown shortly after the gorse is burned it is sufficiently covered by the ashes.

Moss (or "Fog") in Pasture.—As a general rule, the presence of moss in pasture is associated with poverty of soil, or deficient drainage, and in such cases attention to the predisposing condition will result in more vigorous growth of grass, followed by disappearance of the weed. Very often moss is only noticed during winter when the pasture is bare, and as soon as the grass begins to grow in spring the moss is suppressed.

In some cases heavy rolling has resulted in clearance of moss, and it may be mentioned that in some unexplained way superphosphate also has a directly destructive effect on it. Generally speaking, however, if attention is paid to strengthening and improving the grass, the moss will automatically disappear.

Effect of a Dense "Sod."—In hill soils originally fairly good, but containing little or no lime, and particularly if grazed with sheep alone, it commonly happens that a very dense growth of bent grass is found. In such circumstances the dead roots, stems, and leaves of this weed-grass decay very slowly, and ultimately form a spongy layer or sod, which is almost peaty in character and may be several inches in thickness. In a dry climate this layer, by retaining all or most of the water falling on the area, may prevent the

growth of all useful vegetation, and furthermore, may make manuring of any kind practically useless. Even after weeks of rain the soil beneath the sod is sometimes perfectly dry and dusty. In such cases, except perhaps for superphosphate, which will kill whatever moss there may be on the surface, no manure has any effect, probably because it does not reach the soil for which it is intended. The only method likely to effect any improvement in such cases is to cut up the turf and thus facilitate the entrance of water into the soil. Thorough harrowing with ordinary toothed harrows and discing have proved effective in cases where the subsoil is not too open, but obviously it is only in certain types of hill pastures that this treatment can be applied. It should be done in early winter, and followed soon after, if possible, by a dressing of basic slag or lime. This is the kind of land that may often be ploughed up with advantage. After 2 or 3 years' cropping it can be laid down again to grass, a process that is now much simplified by the use of the seed of wild white clover.*

Manures for Hill Pasture.

Liming and Draining.—The old standard method of improvement was liming, preceded, where necessary, by draining. Generally speaking the latter is as essential as ever as a preliminary to further improvement of wet land. There are, however, parts of many hill grazings which are worth more in their undrained condition for the sake of affording rough pasturage at particular seasons, than they would ever be if drained and improved in any practical way. With more expensive labour and coal, and the fact that so many of the old lime kilns have, through long neglect, become unfit for use, it is doubtful if the value of the improvement which lime generally effects on old grass of all kinds, would cover the cost of the material and of the labour involved in applying it, except in special circumstances.

The Use of Phosphates.—In the greater number of cases the improvement of poor pasture depends upon the supply of readily available phosphates. In the case of Down pasture, for instance, a dressing of basic slag will often produce herbage of higher feeding qualities for all farm animals. A slagged Down in the South of England has been found in a normal year to produce tegs and lambs quite fit for the butcher without any artificial feeding, while steers come into the yards in October in very forward condition. The value of basic slag in effecting an improvement in ordinary poor hill pastures is also

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* *See* also "Trials of Wild White Clover" in *The Journal of the Board of Agriculture* for December, 1909.

shown by the results of the experiments conducted by the Highland and Agricultural Society of Scotland. The basic slag should be applied at the rate of, say, 8 to 10 cwt. per acre. Where the rainfall is abundant and the soil well stocked with organic matter, raw mineral phosphates have given results little short of those obtained by the use of basic slag, and at considerably less cost. An adequate supply of water in conjunction with the carbonic acid always present in such soils, helps to render the phosphate available for plant growth. For this reason both mineral phosphate and basic slag should be applied as early in winter as possible, particularly if the slag is of low citric acid solubility. In purchasing basic slag it is well, whenever possible, to select one of high citric acid solubility. It appears to make little difference whether a high grade or a low grade slag is used provided the soil receives an adequate amount of citric soluble phosphate. (*See* also Leaflet No. 267, *Basic Slag.*)

It may here be remarked that before deciding finally on phosphatic manuring an acre or two should be treated experimentally with different forms of phosphates. If none is effective, or if the improvement does not appear sufficiently great to repay the outlay in the course of a reasonable period, some system other than mere manuring should be attempted. It should, however, be pointed out that the improvement is often a permanent one, or at any rate one lasting for many years, so that, in many cases, one should not look for a full return for some considerable time.

Whitehall Place, London, S.W.,
August, 1913.
Revised, January, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Cultivation of the Mushroom.

Mushrooms are sometimes regarded, particularly by small growers, as an uncertain crop. Failures may be due to bad spawn—especially when the crop has been grown indoors, to the unsuitability of the structure, or to the quality and preparation of the manure. Provided, however, that proper attention is given to them, mushrooms may be grown either out of doors or inside with excellent results, and there is no doubt that their culture could with advantage be greatly extended.

The Mushroom House.—No hard and fast rules need be laid down as to the nature of the house. Good results may be obtained in a plainly constructed lean-to shed with thatched roof, or in a cellar. The essential features are darkness and a fairly equable temperature. To obtain the latter during the warmest months of the year, the house, if constructed above ground, should be given a northern aspect. An earthen floor will ensure humidity. For winter culture the installation of hot-water pipes will be a distinct advantage, providing the temperature is well regulated.

The spaces for the beds may be constructed of wood or bricks. The latter are much the more durable, though many growers prefer woodwork. If woodwork is chosen, it must be strong, especially if it is decided to have another tier for successional beds. This economises space, but at least three or four feet should be left between the tiers to admit of proper working. Each bed should be two feet six inches deep. Less depth would suffice, but the beds will continue in bearing longer, and be generally more satisfactory, if the depth stated is allowed.

Preparation and Spawning of Beds in Houses.

The preparation of the manure for inside beds is important. The manure from corn-fed horses is best; it should be freed from the longest litter, but the shortest straw ought not to be too searchingly removed. The newly collected droppings should be spread out in a dry shed not exposed to the sun and drying winds, and turned frequently to allow the rank heat to escape. Afterwards the dung may be thrown into a heap and turned occasionally, and whilst still warm be brought together and rammed firmly to form the bed. The temperature should

then be tested. A stick in the hands of an experienced person may be a sufficient guide, but a bottom heat thermometer is more satisfactory. The mercurial bulb is encased in a sharp pointed brass tube which can be thrust into the bed and read at any time without removal. The rise in temperature should be noted daily. Spawning should take place, when the heat is on the decline, at about 80° to 85° F. The spawn should be of the best quality obtainable, and procured from a reliable source, as it is folly to use cheap or second-class material. The cakes of spawn should be soaked in water if very dry, though this is only necessary during the summer months, or when they have been left exposed to the air for a long time. They should be broken up into pieces about as large as a hen's egg and inserted in the bed some three inches deep in holes from nine inches to a foot apart, and then firmly covered over. About a week afterwards, if the spawn shows signs of running, the bed should be soiled over, a layer of fresh turfy loam two inches deep, and beaten thoroughly firm, being the best for the purpose. If this is at all dry it should be watered ; a hard surface will be no deterrent to the crop. The soil should then be covered with a mulching of clean straw, which will prevent undue evaporation of moisture. The date of spawning should be noted.

The interval from the time of spawning until the beds commence to bear varies, but if all goes well young mushrooms may be expected in about six to eight weeks' time, and as soon as these are noticed the mulching should be removed, as in a warm structure it tends to harbour insect and other pests. Throughout the season of growth the temperature should be kept between 55° and 60° F., according to the conditions out of doors, and damping down should be done as often as necessary to ensure a humid atmosphere. This will be governed entirely by the natural surroundings, but the walls and paths should be kept damp, using as little fire heat as possible. To provide additional warmth some newly gathered droppings should be spread in the pathway and turned once or twice daily.

Beds in the Open.

Those who have not the convenience of a mushroom house, cellar, or any similar suitable place, may with confidence try the formation of a bed out of doors, provided it is built in time to be coming into bearing in the early autumn. Mushrooms may be cut in the open, the whole season through, if beds are spawned in succession, though winter-bearing beds need to be covered with a thick layer of straw in severe weather. The site for spring and summer bearing beds should be shaded from the hottest of the sun's rays. It should be

slightly above the natural level, so that surface water drains away readily. Beds constructed out of doors differ in one respect from those built inside, *i.e.*, they are ridge formed with a base usually from five to six feet wide. The material should be firmly trodden and rammed as the work proceeds. The manure requires preparing exactly as for other systems, but excellent crops may be obtained by the use of equal parts of manure and leaves if the latter are not too decayed, and where a liberal supply of leaves is obtainable their combination with horse manure is to be recommended, for the heat generated is much more lasting and even.

Commercial Culture.

Although the foregoing principles are applicable to the cultivation of mushrooms generally, the methods adopted are in many cases somewhat different when the crop is grown on a commercial scale. Quantities of first class mushrooms are grown in old limestone pits, shale mines, quarries, disused railway tunnels, underground cellars, old ice houses, sheds, empty rhubarb forcing houses, and similar positions. Any place which can be kept dark, and where sufficient manure for new beds can be stored to maintain a temperature of 60° F., is suitable.

Where mushrooms are to be grown on a fairly big scale a large quantity of manure is necessary. Only the very roughest of the straw is removed, and the manure is heaped and turned over for a few days to prevent violent heating, or "fire fang," as it is often called. The manure is then lowered or wheeled into the mines or pits, or conveyed to tunnels in waggons by a central line of rails. In many cases a box 3 ft. deep, 3 ft. 6 in. to 4 ft. broad at the base, and with open top and bottom, the top opening being usually 18 in. to 2 ft. broad, is used. This box is usually made the length of the beds, which are run off at right angles to a broad central path at least 6 ft. wide. Having placed the box in position, the manure is alternately forked into the box and trampled down hard until it protrudes above the top opening. The box is then lifted off and moved along sufficiently far to allow 18 in. between the beds at their base. This process is continued until all the manure which may be ready at the time is disposed of. As soon as the temperature falls to about 85° F., pieces of spawn 2 in. to 3 in. in diameter are inserted in the beds 2 to 2½ in. deep and about 18 in. apart.

Within a few days of spawning the beds are soiled over with 1½ in. of ordinary black garden or other surface soil. This is sometimes applied by placing a box sufficiently large over the bed to allow of the desired coating of soil being packed down all over the bed. By means of a mason's

trowel or an ordinary garden spade and a can of water, a very smooth surface is made on the bed. As soon as one batch of beds has been finished, another batch is commenced, and a continuous supply of heat is thus obtained.

In places such as pits, caves or tunnels, the beds are not so liable to dry and are seldom hayed and strawed. As soon as the flush of the crop is over, the beds are watered with tepid water in which sulphate of ammonia has been dissolved, at the rate of half a teaspoonful to three gallons. Rough agricultural salt is used by some growers in a similar manner, in slightly higher proportions, with good effects. As a result of such treatment, a second crop is obtained, and the beds continue to bear for a much longer period.

Gathering the Crop.

The gathering of the crop is an important feature. The mushrooms should never be cut with a knife, but given a sharp twist and pulled clean out, the lower portion of the stem being cut off afterwards. The beds must not be allowed to become dry. They should receive periodically a good soaking of tepid water, and beds that have been in bearing some time may be rejuvenated by watering with liquid farmyard manure diluted with four times its bulk of water. Some beds, if allowed to remain, will continue to bear more or less for a long time, but usually it is best and most convenient to clear out the old manure, which is useful in a variety of ways, and to use new material for another crop.

The mushrooms are usually sent to market in 1-lb. punnets, and in baskets holding 2 or 3 lb., or more. They bear transport well, with little packing, and, if proper arrangements for marketing are made, they may be expected to pay well during the winter and spring months.

Whitehall Place, London, S.W.,
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Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 277.

BOARD OF AGRICULTURE AND FISHERIES.

Tuberculosis in Farm Stock.

Tuberculosis is a disease caused by a particular species of minute organism called the tubercle bacillus.

The disease is contagious. It has a very wide distribution and affects man and many different species of mammals and birds. The prevalence of tuberculosis amongst cattle is very great, particularly amongst dairy cows. Probably not less than 25 per cent. (1 in 4) of adult indoor cattle in this country are affected. Swine also are frequently attacked, and in them the disease is often of bovine origin; that is to say, they become infected through eating the diseased organs of tuberculous cattle or through being fed upon whole or skimmed milk from cows with tuberculous udders.

Of the other domesticated mammals, horses, cats, and dogs are susceptible to tuberculosis, but very few cases have been recorded as occurring in sheep and goats.

The bacilli on gaining entrance to the body may become established in various parts or organs and multiply there, causing alterations in the cells and destruction of tissue. In this way the characteristic nodules or tubercles are formed, and in consequence of their formation there is interference with the function of the part or organ. In addition to causing local effects, products of the bacilli are absorbed into the system and interfere with the general health of the animal.

The bacilli are capable of living for some time outside the animal body, but are killed by exposure to disinfectants, to a sufficiently high temperature, or to the action of direct sunshine. In a moist state, as for example when suspended in milk, the bacilli are killed by boiling, or by exposure for a quarter of an hour to a temperature of 85° C. [185° F.].

In ordinary circumstances the tubercle bacillus does not multiply outside the animal body. Infection takes place through the taking in by a susceptible subject of the actual bacteria discharged from a diseased animal.

The Virulent Material and its Distribution.

The material excreted from diseased organs which have natural openings very frequently contains tubercle bacilli. The number depends on the extent of the lesions and the activity of the bacilli in the lesions. The more actively the tuberculous degeneration is going on in the tissues of an organ, the more virulent are the discharges from it likely to be, but for purposes of eradication it must not be assumed that because the extent of the lesions is slight the discharges from the affected organ are not infective. Tubercle bacilli may be coughed up and excreted in the mucus from an infected lung. They may be discharged from the intestine, if the inner coats of the latter are the site of tuberculous injuries, or the excretions from the healthy intestine may be rendered virulent owing to infected mucus from the lungs having been swallowed. The milk from a tuberculous udder is often highly virulent, and in advanced cases of the disease the milk may contain tubercle bacilli although the udder is not affected. When the uterus is tuberculous, there is often an infective discharge from the external genital organs. Sometimes tuberculous abscesses form in connection with the superficial lymphatic glands and the skin, and the pus from such abscesses is virulent. The above are the principal methods by which the bacilli are excreted and distributed in the cowsheds and on the pastures, and even the drinking water may be contaminated. It is important to note that as a general rule the advanced cases (piners or wasters) provide by far the largest amount of virulent material.

Methods of Infection and Distribution in the Body.

Animals usually become infected with tuberculosis in one of two ways, *viz.*, breathing or swallowing. It is also possible for infection to take place by inoculation through the skin, but this is not a common method of natural infection. In cattle the common method is by breathing air laden with tubercle bacilli. The result of inhaling the bacilli is, that tuberculosis of the lungs and of the lymphatic glands connected with them is liable to follow.

The disease is usually of a chronic nature, and may for a long time be confined to comparatively small areas of the

lungs. In some cases, however, the infected areas increase in size, until a large part of the lung tissue becomes consolidated. From these areas the bacilli may be conveyed by the lymphatic vessels to the lining membrane of the chest and set up a tubercular pleurisy. From the lung lesions the bacteria may also escape into the air passages, and pass upwards to the throat, where some are coughed or snorted out into the air.

The majority of those which reach the throat from the lungs do not pass out in this way, but are swallowed, and most of these reach the outer air with the faeces of the animal.

Some of the bacilli may pass through the intestinal wall, be carried to the lymphatic glands in connection with the intestines, and set up new centres of the disease there. From these glands the disease may spread to the peritoneum (the membrane surrounding the intestines), to the lymphatic glands of the udder and from these last to the tissue of the udder itself.

The disease may also spread to the liver and kidneys, and rarely in cattle to the tissue of the spleen. In cows the uterus is not uncommonly affected in advanced cases. The lymphatic glands of the throat are sometimes affected.

The intestines may also be infected by virulent material which has been swallowed. Very frequently, however, the bacilli pass through the intestinal wall without causing lesions and lodge in the mesenteric glands, forming centres for further infection. The feeding material which is most likely to cause tuberculosis in this way is tuberculous milk. A fruitful source of infection in pigs is the mixed by-milk from creameries.

An animal may become extensively affected with tuberculosis without the bacilli passing into the blood stream. In a minority of cases the bacilli do gain access to the blood stream, and are distributed with the circulating blood over the whole body. When that has happened the disease is said to have become generalised, and the most constant result of generalisation is the formation in the lungs of numerous small, grey or yellow, nodules up to the size of a hemp seed. The term *miliary* tuberculosis is applied to this form of the disease.

Symptoms.

The symptoms of tuberculosis during life are often not very distinct. Frequently there is a chronic cough and troubled breathing, with more or less anæmia and wasting. When there are abdominal lesions there is usually some diarrhœa.

In many cases the disease runs a mild chronic course and the animals show hardly any signs of being tuberculous. In such cases the presence of the disease is sought for by the aid of a preparation named Tuberculin, which when injected under the skin of an animal affected with tuberculosis causes a definite reaction in the shape of a rise of temperature. When non-tuberculous animals are tested in this way there is no such marked effect. Tuberculin may also be applied in other ways, which it is not necessary to enter into here.

A very important seat of the disease in cows is the udder, on account of the discharge of the bacilli with the milk, and the consequent danger of infection to milk-fed animals and human beings. The udder does not usually become affected until the cow is in a fairly advanced stage of the disease.

The hinder quarters of the udder are as a rule first affected, and the disease may manifest itself in one or both of these quarters. There is a swelling, which is hard and painless. It is slow in growth, but the growth steadily progresses. Sometimes the swelling is somewhat irregular. In many cases, however, it is diffuse and very hard, and one or more quarters may be completely indurated. This is due to the excessive growth of fibrous tissue which destroys the gland tissue proper. At first the milk remains normal, but as the disease advances the milk of the affected quarter or quarters becomes thin and watery. Later it decreases in amount, and becomes flaked. The milk from the affected quarters contains tubercle bacilli, and microscopic examination of the milk may determine whether a suspected cow is affected or not. (The chances of demonstrating bacilli in the milk by microscopic examination are greatly increased by making use of the centrifuge and other methods of laboratory technique.)

On post-mortem examination the lesions of tuberculosis are usually easily recognisable as such by a competent observer, without recourse to anything but a naked eye examination.

Preventive Measures.

Various schemes have from time to time been put forward having in view the eradication of the disease; most of them involve the periodical use of the Tuberculin Test, followed by the isolation, segregation or even destruction of re-acting animals. These plans are open to criticism from the economic point of view, and no doubt if adopted

generally would involve a huge expenditure, but it is beyond dispute that the disease has been eradicated from many herds by employing these methods, and sometimes with comparatively small expense.

It has to be borne in mind that the chief factor in the spread of the disease amongst cattle and also from cattle to man, is the existence of animals in an advanced stage of the disease, and particularly of cows with tuberculous udders. These sources of infection can be removed on detection, and their removal involves no more than the destruction of animals which are already either unprofitable or would soon become so.

It should further be pointed out that the more animals are kept indoors and crowded together in insanitary surroundings, the more likely is the disease to flourish, as given the presence of a tuberculous animal these conditions favour the spread of the disease to other animals in contact. It must not be thought, however, that the disease can be eradicated from an infected herd by providing a generous allowance of cubic space, and freely ventilating the buildings, for tuberculosis has been known to spread alarmingly in excellent cowsheds, and even cattle at pasture run serious risk of infection, if they are in association with other badly infected cattle. The latter remark is not intended to belittle the importance of allowing a reasonable amount of cubic space per animal in the cowsheds, but to accentuate the importance of ridding a herd of the infective animals. After what has been said above it is unnecessary to enlarge upon the danger of allowing calves to suck a cow with a suspicious udder, or one which is in the advanced stages of tuberculosis. The milk of such cows should not be used to nourish animals or human beings. With regard to the by-products from creameries, separated milk for example, which is employed in some districts as food for pigs, the great risk connected with its use has already been referred to. It owes its dangerous quality mainly to the fact that it is the product of a very large number of cows, and the more cows contributing to the milk supply the greater will be the number supplying tuberculous milk. Creamery products, however, can be rendered harmless by exposing them to a temperature of 85° C. [185° F.] for fifteen minutes or by bringing them to the boiling point.

Common feeding or drinking troughs should not be used, especially in infected herds.

Since tuberculous animals excrete virulent material into the cowsheds mainly from the lungs and the bowel, the need for frequent cleaning and disinfection of

cowsheds, particularly the parts most liable to be contaminated by the mucus from the lungs and the faeces, is all the more pressing. In the liquid state these virulent materials may cause infection of the food or water by direct contamination, but it must not be forgotten that, if left to dry into dust, the dust may permeate the air of the cowshed, and be inhaled by other animals in more distant contact or even contaminate their food.

The Tuberculosis Order of 1914.

The Tuberculosis Order of 1914 requires every person having in his possession or under his charge—

(i) any cow (including a heifer that has calved) which is, or appears to be, suffering from tuberculosis of the udder, indurated udder or other chronic disease of the udder ; or

(ii) any bovine animal (*i.e.* a bull, cow, ox, heifer or calf) which is, or appears to be, suffering from tuberculous emaciation ; or

(iii) any bovine animal which is suffering from a chronic cough and showing definite clinical signs of tuberculosis

to give information of the fact without avoidable delay to a constable of the police force for the area wherein the animal is, or to an Inspector of the Local Authority.

"Tuberculous emaciation" means emaciation due to tuberculosis.

The Order further requires that the person in possession or having charge of the animal shall keep it isolated as far as practicable from other bovine animals, and keep it in his possession or under his charge until it has been examined by a Veterinary Inspector of the Local Authority in accordance with the provisions of the Order, and the owner or person in charge of the animal has been notified that the provisions of the Order have ceased to apply to the animal. In cases where the animal is giving milk, the milk must be boiled or otherwise sterilised and not mixed with other milk, until the animal has been examined by a Veterinary Inspector and until either three clear days after the examination have expired or the owner or person in charge has been notified as above. Any utensil in which the milk has been placed before being so treated must be thoroughly cleansed with boiling water before any other milk is placed therein. The foregoing restrictions as to the use, &c. of

milk come into force again in the event of notice of intended slaughter of the animal being given by the Local Authority.

Any contravention of the provisions of the Order renders the person or persons concerned liable on conviction to a **fine of £20.**

The Order requires the Local Authority to cause every cow or other bovine animal coming within the above-mentioned category to be examined by a Veterinary Inspector, and if the report of the Inspector shows that the animal is suffering from tuberculosis of the udder or tuberculous emaciation or giving tuberculous milk, or suffering from a chronic cough and showing definite clinical signs of tuberculosis, they are required to cause the animal to be slaughtered, unless the owner or a person on his behalf gives notice in writing that the owner objects to the animal being slaughtered, or the value of the animal exceeds £30, in either of which events slaughter by the Local Authority cannot be proceeded with except by special authority from the Board. For every animal slaughtered under the Order compensation, based on the market value of the animal, is payable by the Local Authority in accordance with the provisions of the Order.

Copies of the Tuberculosis Order can be obtained from the Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W.

Whitehall Place, London, S.W.,
November, 1913.

Revised, August, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 278.

BOARD OF AGRICULTURE AND FISHERIES.

The Growing of Linseed for Feeding Purposes.

In order that the dairy farmer may produce milk most economically, and realise the maximum return on invested capital, it is imperative that he should (amongst other things) maintain a deep milking strain of cows. As a means to this end the rearing of the heifer calves from his best animals is all-important. Furthermore, it is desirable that as large a number as possible of calves of the beef type should be reared for fattening purposes. In view of the great and ever-increasing demand for milk, and its consequent high price, its use as an economical food for calves is an impossibility.* Skim milk may be employed, but a substitute for the fat is necessary. Linseed as a source of easily digestible fat at once suggests itself, but at current winter prices it is an expensive food. The question therefore arises —can the English farmer produce linseed at less cost than he can buy it? From experiments which have been conducted, it would appear that this question can be answered in the affirmative. Indeed, there is evidence to show that it may be grown profitably for sale.

In some parts of the world flax is grown for seed only, and in other parts for fibre (seed being a secondary consideration), but the object at which the British stock farmer should aim is probably the production of a full crop of seed. This is the system in reference to which the following suggestions on cultivation are given.

Kinds.—The common Flax belongs to the genus *Linum*, of which there are about 90 known species. So far as the practical farmer is concerned there is only one cultivated industrial species, viz., *Linum usitatissimum*.

Soil.—Flax grows on a wide range of soils of varying fertility. Those best suited to its culture are deep, moist, medium loams which are well drained and in a good condition of fertility, overlying rather heavy, compact subsoils. In favourable seasons when heavy bean soils can be

* See also Leaflet No. 142 (*Calf Rearing*).

reduced to a fine tilth, excellent crops can be grown thereon. Calcareous soils, on the other hand, seem to have a stunting effect on growth. Although the class of soil and its fertility are important determining factors, the preparation of the land as it affects mechanical condition is also of great significance.

Rotation.—The importance of a suitable rotation is fully appreciated on the Continent. Many different rotations are adopted, but all agree in not including flax too frequently. Authorities differ as regards the exact time which should intervene between two flax crops in the rotation; on an average seven years is the period allowed. Examples of rotations are :—

Belgium.—Clover, wheat, rye, potatoes, wheat, oats, flax with clover

Holland.—Oats, wheat, potatoes, oats, flax, oats with clover and grass seeds, hay, grazed for two years.

Since linseed requires a clean seed-bed, it may be advisable to take it after a root crop, but excellent crops are often grown after a heavy oat crop, which leaves a clean stubble. If the soil is rich, flax may follow oats; if poor, the crop is sometimes taken after clovers. Flax may be sown by itself or with clover seeds, which, according to some authorities, do better with flax than with any other crop.

Preparation of the Soil.—A fine, clean, compact seed-bed is required. This allows of the seed being covered to a uniform depth and also permits uniformly rapid germination, this being very important. In order to secure this the land should be autumn ploughed to a depth of seven to eight inches. In spring, if the soil is of a heavy nature a shallow ploughing of three to four inches may be necessary, but grubbing and cultivation followed by harrowing and rolling will generally give the desired result. A farmer may find, however, that owing to the peculiarity of the season or because of economic or other conditions, *e.g.*, sheep feeding on green crop, he is unable to sow some of his intended cereal "break" with spring corn. In this case, if a suitable seed-bed can be obtained after the crop has been eaten off, a few acres of linseed may be sown instead. Compactness is an important feature of the ideal seed-bed, as it allows of the ascent of water from the lower strata to the somewhat shallow root system of the crop. The soil should be worked deeply and then consolidated, especially in the drier localities, in order that it may maintain all through the growing period a sufficiency of moisture and so allow of a full development of seed. On no account must the seed-bed be loose and friable.

Manuring.—Land must not be in too high condition, or the crop is liable to "lodge." Farmyard manure is most

suitable when applied to the crops preceding flax, especially if a good quality fibre is desired. If applied directly, and this is admissible in the case of seed production, it should be well rotted. In a fresh state it causes a too luxuriant growth, which increases the possibility of "lodging," and tends to encourage weeds, thereby increasing the cost of subsequent cleaning. Since flax has a short period of growth and a comparatively small root system, the food material should be in an available state. Excellent results can be obtained by the judicious use of artificial manures. Potash is the chief artificial manure used for fibre production, as it checks "yellowing," a disease which attacks the plant in the early stages of its growth. The Department of Agriculture and Technical Instruction for Ireland recommend its application in the form of 5 cwt. kainit or 1¼ cwt. muriate of potash per acre.

For seed production the following is suggested:—½ to ¾ cwt. sulphate of ammonia, 3 cwt. of superphosphate, and ½ to ¾ cwt. of muriate of potash per acre, applied immediately before seed sowing. It is the general opinion of farmers that flax is an exhausting crop, but this is not borne out by experiment. It is not a more gross feeder than wheat; in some cases better crops of wheat have been got after flax than after wheat.

Variety to Sow.—Too much care cannot be taken in the selection of the proper type of seed to grow. Russian seed and Russian seed grown one year in Holland have given very good results in the South of England. In order to test the seed- and straw-producing powers of different types of flax, some twenty-three lots exported from various ports and supplied by the Seed Crushers' Association were grown at the Experiment Station of the East Anglian Institute of Agriculture in 1912. It was found that while some Russian lots produced 18 cwt. of seed and 32 cwt. of straw, lots from Bombay and Calcutta produced 12 cwt. of seed and 11 cwt. of straw. The length of the straw ranged from 10 inches in the latter to 3 feet in the former.

Chinese linseed produced a large amount of foliage and reached a height of 2 feet, but was a failure, as the plants "lodged" readily after rain and the seed never ripened. The seed produced by the several lots was of excellent quality, as will be seen from the following table :—

—	Calcutta.	Morocco.	Odessa.	Steepe.	Turkey.	Berdiansk.
Oil	36·13	38·36	39·65	30·23	35·09	30·26
Albuminoids	22·12	23·00	23·50	20·81	22·12	21·56
Soluble Carbohydrates	18·36	19·49	18·58	17·31	18·65	19·52

Apart from the question of source of seed, it is very important that the sample should consist of plump, well-developed seeds of good colour, and be free from weed seeds. It should be remembered that linseed absorbs moisture readily and thereby loses its vitality; it must therefore be kept in a cool, dry place.

Chaff.—9 to 12 cwt. of chaff may be obtained. This consists essentially of the remains of the seed bolls after the seed has been threshed out. It is fed with good results in conjunction with other dry foods, *e.g.*, oats, bran, &c., to ewes, which eat it with avidity. Ewes with lambs, however, should not be supplied with it, as the large amount of fibre which it contains renders it quite unsuitable for young stock. When supplied at this time it has been the cause of a considerable number of deaths amongst lambs in different flocks.

Time of Sowing.—No special time of sowing can be suggested, owing to diversity of climate and season. It is held by many that linseed is killed by frost, but white frost has been seen on linseed plants, which were not in the least harmed and ripened perfectly. It may be advisable, however, to delay sowing until all likelihood of frost is past. It is sown from April to the middle of May; perhaps the beginning of May is the best time. If the seed is sown late and drought sets in the crop will be stunted.

Method of Sowing.—Either broadcasting or drilling may be practised. In districts where the best fibre is produced the former method is adopted. The seed, being flat and smooth, runs readily from between the fingers, and care is required to give a uniform distribution. When the seed is drilled the outermost plants in the drills branch more than those towards the centre, and this is fatal to the desired uniformity in the fibre. Where it is grown for seed, drilling may conveniently be adopted, and this method means not only a saving of seed, but of weeding, as after-cultivation can be practised. An ordinary corn drill may be used, the coulters being set about eight inches apart.

Rate of Sowing.—For seed production a satisfactory "plant" will be obtained on tilthy land by broadcasting 70 to 80 lb. or drilling 40 to 60 lb. per acre. If sown too thickly the plants will be crowded, and on each plant only one or two seed bolls with poorly developed seeds may develop. Seed production demands strong branching plants with large leaf surfaces, and plenty of aeration. Thicker seeding is practised for fibre production, as much as 3 bushels (156 lb.) per acre being sown in some districts.

Depth of Sowing.—In order to obtain a uniform sample of seed at harvest time, it is most important to have all the seeds covered to the same depth. This can be secured by drilling on a uniformly fine compact seed-bed obtained in the manner

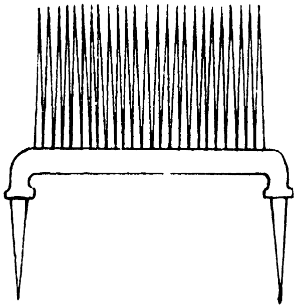
already described. If buried too deeply, most of the seed energy is expended before the leaf is formed, the result being a dwarfed crop. The depth which gives the best results is ½ inch to 1 inch. The seed should be harrowed in with a light iron harrow having closely set teeth, and then rolled.

Weeding and After-cultivation.—It is well to take flax after a cleaning crop, or at least to sow it on clean land. Good farming is the great preventive of weeds, and perhaps no crop shows the advantages which accrue therefrom more than flax. The presence of weeds not only lessens the amount of food material available for the flax plant, but hinders the curing and drying of the seed bolls at harvest time, and reduces the selling value of both seed and fibre. When the crop is drilled one hand-hoeing may be given. All pulling of weeds should be done when the soil is fairly moist, or the flax may be uprooted or have its roots exposed. Deep-rooted plants like thistle and dock should be spudded. Convolvulus and dodder are perhaps two of the most troublesome weeds in the flax crop. Care should be taken that the seed sown does not contain the seeds of these plants. All plants noticed to be affected with dodder should be pulled up and burnt before the parasite has time to flower. (*See* the Board's Leaflet No. 180.)

Harvesting.—If the seed is sown about the end of April or the beginning of May, the crop will be ready for harvesting in August, three to four months being required according to the season. The seed should then be plump, well developed, bright, and brown in colour. It may be reaped a little before it is quite ripe, as it matures in the "shock" like wheat. The crop may be pulled by hand, or, where suitable varieties have been sown, cut with hook or reaping machine. The fibre, however, is much more valuable from a crop which has been hand-pulled, as a longer fibre is then obtained. If a reaping machine is used, the knife must be very sharp, the teeth on the cutting board fairly close, and the crank action quick. This allows of clean cutting being done with the minimum of trouble and at the least cost. When the reverse conditions exist the process is one of "chewing" rather than cutting, and unsatisfactory work is the result. The sheaves, which should be small, to allow of rapid curing, are "shocked" in the ordinary way. In order to lessen the risk of injury from wet and of losing seed in subsequent handling, the crop should be carted directly it is fit. A sheet should be spread on the floor of the cart to catch any bolls which may be broken off.

Threshing.—If only a small area of flax is grown the crop may be threshed with a flail. This separates all the bolls from the straw, and breaks the majority of them, but a considerable number will be left unbroken. Further breaking

can be done by running a garden roller over them, when the seed can be separated from the chaff by passing it through a



RIPPLING COMB.

winnowing machine. Another method is to pull the straw through a rippling comb, which removes the bolls, when these can be crushed with a roller. Satisfactory results have also been got by passing the unthreshed straw through a mangle, which breaks the bolls and allows of the seed being readily knocked out. If one of these methods is adopted the straw is not broken or destroyed. Where a comparatively large acreage is grown, resort may be had to the ordinary threshing machine, which, however, does not, as a rule, do very good work. To ensure the best results it should be set as close as possible and be maintained at a high speed. The straw in this case is not so valuable, as it is broken up by the drum.

Value of the Straw.—The straw makes excellent packing material for crockery, and in some districts it might meet a ready sale for this purpose. On the farm it is most useful for thatching purposes, and being very tough it lasts for a considerable time. Irish experience indicates that if the straw is properly dried and evenly put up it would be worth for retting purposes £2 to £4 per ton, according to length and quality, delivered at the rettery. It is essential, however, that the quality should not be impaired during the drying process and that the straw should be kept quite straight and even in the sheaves. This can be accomplished if flailing or rippling is the means of threshing adopted, or if the seed is removed by introducing only the upper end of the straw into the drum of the threshing machine.

Summary.—The following advantages are derived from the growing of linseed :—

1. As a food for stock it can be grown more cheaply than it can be purchased at present prices on the open market.

2. It allows of the profitable employment of land which, owing to lateness of the season, cannot be sown with spring corn.

3. In a dry early season it can be removed in time to allow of a catch crop being taken.

Whitehall Place, London, S.W.,

December, 1913.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 279.

BOARD OF AGRICULTURE AND FISHERIES.

Technical Advice for Farmers.

Although the English farmer has usually a wide and extensive knowledge of the ordinary principles of cultivation and breeding, cases constantly arise in which his experience may usefully be supplemented by the knowledge of the specialist who has made a study of some particular branch of agriculture. The most obvious example of this occurs in the treatment of diseases of plants, the nature of which cannot usually be identified by the farmer. Many of these diseases lead to serious losses, and it is only to the expert that the farmer can turn for reliable information as to their prevention or treatment.

At a time like the present, when the values of crops, manures and feeding stuffs have altered so greatly, when changes occur from week to week, when new machines and implements are required and when practices more or less unusual are being adopted, even experienced farmers may wish to have the benefit of the knowledge gained by others.

Advice on agricultural matters, moreover, is needed not only by the experienced, but also by the inexperienced cultivator and by the small holder who may not always have that knowledge of the best agricultural practice which it is assumed the practical farmer possesses. There are many facts or methods which are still not matters of common knowledge, although known and accepted by well-informed agriculturists. Among them may be mentioned the economic uses of manures and feeding stuffs; the merits of particular strains of seeds; and the manufacture of different types of dairy produce.

During the past few years the Board have given much attention to means of providing advice for agriculturists, and they are gradually organising a system by which it is hoped to provide full and accurate information for all who desire to avail themselves of it.

The system is one which will take a number of years to develop fully; it is as yet in an early stage, and under ordinary circumstances it would have been preferable to delay reference to it until the arrangements were more complete; but if properly utilised the system is already capable of providing much assistance for agriculturists, and in view of the present need for employing every possible resource, some account of it is desirable.

Leaflet No. 279.

For the purposes of agricultural education, the Board have divided England and Wales into twelve groups of counties, each group constituting a "province." A list of the counties comprising each province will be found in the first column of the Schedule on pages 5–10. The aim has been to secure for each county a staff of competent Instructors under a Chief Instructor or Organiser, and to provide for each province the services of a well-equipped University Department of Agriculture, or a College with a staff of expert teachers and investigators capable of undertaking consultative work in agriculture, and in such of the sciences as bear most directly on the work of the farmer.

Advice through the Staffs of Local Education Authorities.

In many counties in England and Wales, the Education Authorities have already appointed a county agricultural staff, the members of which are qualified to deal with enquiries relating to recognised agricultural practices. Wherever these appointments have been made the Organiser and his staff are now available for the purpose of supplying general advice on agricultural subjects, including dairying, horticulture and poultry-keeping.

In those counties in which a trained agriculturist is employed, his name and address will be found in the second column of the Schedule on pp. 5–10, and persons desiring advice should apply to him; he will either deal with the subject himself or refer the enquirer to some specialist who can help him.

Advice through the Staffs of Universities or Colleges.

In eleven out of the twelve provinces above referred to, arrangements have already been made by which the members of the staff of a university or agricultural college are available for advising agriculturists. Further, with the aid of a grant from the Development Fund, in nine out of these eleven institutions the staff has been specially strengthened by the addition of one or more officers, known as Advisory Officers.

The special business of the Advisory Officer is to deal with enquiries, endeavour to ascertain the subjects within the province that require special study, investigate, or arrange for the investigation of, these subjects, keep in touch with the progress of agricultural research, and endeavour to ensure that new scientific discoveries do actually benefit the farmers of the province. The name "Advisory Officer" was

selected as being a convenient one to distinguish the new members of staff, provided for by a grant from the Development Fund, from other members of the college staff. But while the Advisory Officer is specially charged with the duties above indicated, it should be clearly understood that he is only one of a group of trained men engaged in studying agricultural questions and assisting in providing advice for agriculturists.

It is everywhere recognised that the subjects now embraced under the general term "Agricultural Science" are much too wide to be properly dealt with by one man. Instead of the "consulting chemist" of last century, who answered, or was expected to answer, questions on every scientific subject, there must now be a group of specialists. The only method of securing efficient help is by a system of division of labour which requires every member of the staff of an agricultural college or university department to do his share. Neither the County Organiser nor the College Advisory Officer has any monopoly in the giving of advice, for both are charged with this duty, and the business of each is to see that the enquirer, whether small holder or large farmer, gets the best possible information which may be available.

In those counties in which no Organiser or other trained agriculturist has been appointed, questions should be addressed to the Provincial College (*see* column 3 of the Schedule).

Research Institutes.

Attention may be directed to another group of institutions which, although established for a different purpose, are of the greatest possible value in the scheme for providing advice now under notice.

Research Institutes are institutions set up, or assisted, by grants from the Development Fund for the purpose of making a careful study of certain groups of agricultural subjects. For example, the existing station at Rothamsted was enlarged, and now studies questions bearing on the fertility of soils in a more comprehensive way than was possible formerly; at Cambridge a new Institute has been formed for studying the feeding of animals; the Board have recently fitted up at Kew a new Institute for studying plant diseases; another Institute is now being erected by them at Addlestone, Surrey, for investigating the diseases of animals; at Bristol there is an Institute giving special attention to fruit, and other horticultural questions; at Cambridge there is an Institute for breeding new crops. The whole subject "Agricultural Science" has in this way been divided up into

sections, on which eleven Institutes are already at work. The information provided through these Institutes will reach agriculturists through the staffs of universities, colleges and counties, as well as directly through publications.

Live Stock Officers.

In connection with the scheme for the improvement of live stock, an officer has been appointed by the agricultural colleges in the same way as the agricultural advisers above referred to. These officers will be primarily responsible for the local promotion and administration of the Live Stock Scheme in their respective areas,* but they will also be required to give technical advice and assistance to local agriculturists, and to members of the county staff on questions relating to live stock. The names and addresses of Live Stock Officers will be found in column 3 of the Schedule on pps. 5 and 10.

Forestry Advisers.

England and Wales have been divided into four districts, and an expert forester has been attached to a teaching institution in each district for the purpose of advising applicants on all questions relating to the treatment of their woods. Where an inspection is necessary a fee not exceeding one guinea a day is charged. Since there are only four Forestry Advisers it has not been possible to adhere to "province" boundaries. The counties served by each together with names and addresses will be found in column 3 of the Schedule.

Summary of Arrangements for Advice.

From the foregoing particulars it will be seen that the arrangements made by the Board contemplate, for all branches of the agricultural industry :—

(1) The supply of ordinary information and advice through the County Organiser on the general principles and practice of agriculture.

(2) The supply of advice on more difficult matters, and the investigation of local problems through the medium of expert advisers and other members of a college staff.

(3) Scientific research on agriculture and on diseases of plants and animals, with the object of improving the quality of the information available for agriculturists.

Each of these parts of the complete organisation is intended to supplement the others and to prevent waste of time and energy.

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* *See* Leaflet No. 282 (*Scheme for the Improvement of Live Stock*).

Information supplied by the Board.

In cases in which difficulty may be experienced in getting advice locally the Board are prepared to advise on agricultural questions, and on the treatment of insect and fungus pests, but in view of the importance of local knowledge in dealing with most agricultural questions it is desirable that reference should, wherever possible, be made to the addresses given in the Schedule below.

Attention may be drawn to the Board's monthly *Journal* and to the *Leaflets* issued on practical agriculture and on animal and crop pests; these will be found to contain information on a large number of subjects in regard to which questions are frequently asked. The *Journal* costs 4*d*. per month or 4*s*. per annum, post free. A list of leaflets may be obtained on application; they are issued singly free of charge and post free, and those numbered 1–100, 101–200, and 201–300 are also sold in bound volumes at 6*d*. each, post free.

Addresses to which Enquiries should be sent.

The following Schedule shows the name of the Agricultural Organiser or other officer in each county to whom enquiries may be sent, together with the addresses to which enquiries for the College Advisory Staff should be forwarded. The arrangements are not in all cases complete and further appointments are being made as opportunity offers.

[In those cases where no Agricultural Organiser is shown enquiries should be addressed direct to the College.]

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
1. FOUR NORTHERN COUNTIES.		
Cumberland Westmorland	W. T. Lawrence, Cumberland and Westmorland Farm School, Newton Rigg, Penrith.	*Armstrong College, Newcastle-on-Tyne.* D. A. Gilchrist, M.Sc., Professor of Agriculture. *Live Stock Adviser.* T. B. Schofield, Armstrong College, Newcastle-on-Tyne. *Forestry Adviser.* J. F. Annand, M.Sc., 96, St. George's Terrace, Newcastle-on-Tyne.
Durham ...	—	
Northumberland	—	

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
2. YORKSHIRE. Yorks, East Riding.	Professor R. S. Seton, B.Sc., The University, Leeds.	*Leeds University.* R. S. Seton, B.Sc., Professor of Agriculture. *Live Stock Adviser.* *Walter R. Crawford,* The University, Leeds. *Forestry Adviser.* J. F. Annand, M.Sc., 96, St. George's Terrace, Newcastle-on-Tyne.
Do. North Riding.	*Do.*	
Do. West *Riding.*	Do.	
3. COUNTIES CONNECTED WITH THE MIDLAND AGRICULTURAL AND DAIRY COLLEGE, KINGSTON, DERBY.		*Midland Agricultural and Dairy College.* W. Goodwin, M.Sc., Ph.D., Principal. *Live Stock Adviser.* James Matthews, Midland Agricultural and Dairy College. *Forestry Advisers.* Derby and Leicester :— Professor H. A. Pritchard, F.S.I. Applications to be sent to the Secretary to the Delegates for Forestry, School of Forestry, Oxford. Nottingham, Lindsey and Rutland :— C. Hankins. Applications to be sent to the Reader in Forestry, School of Forestry, Cambridge.
Derby	J. R. Bond, B.Sc., County Education Office, St. Mary's Gate, Derby.	
Leicester ...	T. Hacking, M.Sc., 10, New Street, Leicester.	
Lincoln (Lindsey).	R. N. Dowling, Education Office, 286, High Street, Lincoln.	
Nottingham ...	E. E. Stokes, Shire Hall, Nottingham.	
Rutland ...	T. Hacking, M.Sc., 10, New Street, Leicester.	
4. EASTERN COUNTIES.		
Bedford ...	—	
Cambridge ...	—	
Essex	R. M. Wilson, B.Sc., East Anglian Institute of Agriculture, Chelmsford.	
Hertford ...	Do.	
Huntingdon ...	—	*Cambridge University.* R. H. Adie, M.A., School of Agriculture, Cambridge. *Live Stock Adviser.* W. P. Crosland, School of Agriculture, Cambridge University.
Isle of Ely ...	—	
Lincoln (Holland).	—	
Lincoln (Kesteven).	Fred. Wakerley, M.Sc., Education Office, 64, London Road, Grantham.	
Norfolk ...	—	

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
EASTERN COUNTIES—*cont.*		
Northampton ...	J. J. Green, B.Sc., County Education Offices, Northampton.	*Forestry Adviser.* C. Hankins. Applications to be sent to the Reader in Forestry, School of Forestry, Cambridge.
Soke of Peterborough.	—	
Suffolk, East ...	A. W. Oldershaw, B.Sc., County Hall, Ipswich.	
Suffolk, West ...	—	
5. SOUTH-EAST ENGLAND.		
Kent	G. H. Garrad, Sessions House, Maidstone.	*South-Eastern Agricultural College, Wye.* M. J. R. Dunstan, M.A., Principal.
Surrey	—	
Sussex, East ..	J. N. Jack, County Hall, Lewes.	*Live Stock Adviser.* H. E. Rudd, South-Eastern Agricultural College, Wye.
Sussex, West ...	W. Lawson, 28, North Street, Chichester.	*Forestry Adviser.* Professor H. A. Pritchard, F.S.I. Applications to be sent to the Secretary to the Delegates for Forestry, School of Forestry, Oxford.
6. COUNTIES CONNECTED WITH UNIVERSITY COLLEGE, READING.		
Berkshire ...	G. Smith Bedford, University College, Reading.	*University College, Reading.* Dean of the Faculty of Agriculture and Horticulture.
Buckingham ...	—	
Dorset	T. R. Ferris, M.Sc., County Offices, Dorchester.	*Live Stock Adviser.* T. Hunter, University College, Reading.
Hampshire ...	J. D. Davidson, Farm Institute, Sparsholt, Winchester.	*Forestry Adviser.* Professor H. A. Pritchard, F.S.I. Applications to be sent to the Secretary to the Delegates for Forestry, School of Forestry, Oxford (except Middlesex, which is served by C. Hankins. Applications to be sent to the Reader in Forestry, School of Forestry, Cambridge.).
Isle of Wight ...	—	
Middlesex ...	—	
Oxford	G. R. Bland, County Hall, Oxford.	

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
7. *CORNWALL AND DEVON.*		
Cornwall	W. Borlase, Education Department, County Hall, Truro.	*Seale-Hayne Agricultural College.* B. N. Wale, B.Sc., Seale-Hayne Agricultural College, Newton Abbot. *Live Stock Adviser.* P. A. Mytton, Seale-Hayne Agricultural College, Newton Abbot. *Forestry Adviser.* Professor H. A. Pritchard, F.S.I., 5, Chester Terrace, Lewis Lane, Cirencester.
Devon	F. V. Dutton, B.Sc., Agricultural Laboratories, Richmond Road, Exeter.	
8. WEST OF ENGLAND.		
Gloucester ...	G. H. Hollingworth, Shire Hall, Gloucester.	*Bristol University.* B. T. P. Barker, M.A., Agricultural Research Station, Long Ashton, Nr. Bristol. *Live Stock Adviser.* Wm. Nixon, Agricultural Research Station, Long Ashton, Nr. Bristol. *Forestry Adviser.* Professor H. A. Pritchard, F.S.I., 5, Chester Terrace, Lewis Lane, Cirencester.
Hereford ...	John Porter, B.Sc., Shirehall, Hereford.	
Somerset ...	J. H. Burton, M.Sc., Agricultural Education Office, 5, Graham Road, Weston-super-Mare.	
Wiltshire ...	——	
Worcester ...	R. C. Gaut, M.Sc., 37, Foregate Street, Worcester.	
9. SHROPSHIRE, STAFFORD AND WARWICK.		
Salop	Edric Druce, F.C.S., Shirehall, Shrewsbury.	*Harper-Adams Agricultural College.* P. Hedworth Foulkes, B.Sc., Harper Adams Agricultural College, Newport, Salop. *Live Stock Adviser.* W. Conwy Bell, Harper Adams Agricultural College, Newport, Salop. *Forestry Advisers.* Professor H. A. Pritchard, F.S.I. Applications to be sent to the Secretary to the Delegates for Forestry, School of Forestry, Oxford (except Salop, which is served by Professor Fraser Story, University College of North Wales, Bangor).
Stafford... ...	J. C. Rushton, County Education Offices, Stafford.	
Warwick ...	B. W. Bull, The Farm Institute, Marton, Rugby.	

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
10. LANCASHIRE AND CHESHIRE.		
Lancashire ...	T. Milburn, Ph.D., Agricultural Department, County Offices, Preston.	*Live Stock Adviser.* W. P. Middleton, Victoria University, Manchester.
Cheshire ...	T. J. Young, M.Sc., College of Agriculture and Horticulture, Holmes Chapel, Cheshire.	*Forestry Advisers.* Lancashire— J. F. Annand, M.Sc., 96, St. George's Terrace, Newcastle-on-Tyne. Cheshire— Professor Fraser Story University College of North Wales, Bangor.
11. NORTH WALES.		
Anglesey ...	Griffith Jones, B.Sc., Education Offices, Llangefni, Anglesey.	*University College of North Wales, Bangor.* R. G. White, M.Sc., Professor of Agriculture.
Carnarvon ...	R. H. Evans, B.Sc., Madryn Castle Farm School, Pwllheli.	*Live Stock Adviser.* R. N. Jones, University College of North Wales, Bangor.
Denbigh ...	W. Hopkins Jones, Brynscawen, Warren Road, Rhyl.	*Forestry Adviser.* Professor Fraser Story, University College of North Wales, Bangor.
Flint	W. Hopkins Jones, Brynscawen, Warren Road, Rhyl.	
12. MID-WALES, SOUTH WALES AND MONMOUTH.		
Brecknock ...	David Thomas, County Hall, Brecon.	*University College of Wales, Aberystwyth.* Professor of Agriculture. *Live Stock Adviser.* D. D. Williams, University College of Wales, Aberystwyth.
Cardigan ...	D. J. Morgan, B.Sc., Cambrian Chambers, Aberystwyth.	
Carmarthen ...	D. Johns, B.Sc., County Education Offices, Carmarthen.	
Glamorgan ...	R. Hedger Wallace, University College of South Wales and Monmouthshire, Cardiff.	

Administrative County.	County Organiser or other Agricultural Instructor.	Name of College and Address to which Enquiries should be directed.
MID-WALES, SOUTH WALES AND MONMOUTH—*cont.*		
Merioneth ...	The Professor of Agriculture, University College of Wales, Aberystwyth.	*Forestry Adviser.* Professor Fraser Story, University College of North Wales, Bangor (except Glamorgan and Monmouth, which are served by Professor H. A. Pritchard, F.S.I., 5, Chester Terrace, Lewis Lane, Cirencester).
Monmouth ...	W. J. Grant, County Council Offices, Newport, Mon.	
Montgomery ...	J. L. John, B.Sc., County Agricultural Offices, Berriew Street, Welshpool.	
Pembroke ...	Agricultural Organiser, Education Offices, 8, Victoria Place, Haverfordwest.	
Radnor	David Thomas, County Offices, Llandrindod Wells.	

Whitehall Place, London, S.W.,
March, 1915.
Revised, March, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Sainfoin (*Onobrychis sativa*).

Sainfoin, which, in common with the clovers, is a member of the natural order *Leguminosæ*, has been known and cultivated as a fodder crop on the Continent for some centuries and was introduced into this country about the middle of the seventeenth century from France, under the name of "Finger-grass." The name "Sainfoin," by which it is commonly known, is a corruption of "Saint-foin," or "holy hay."

As a means of enriching the soil in nitrogen, the most expensive manurial ingredient which a farmer has to buy; as a substitute for clover on land subject to "clover sickness"; and as a forage crop with valuable feeding properties, sainfoin is worthy of increased attention. As it may remain down for some years it has the additional advantage of saving labour, an important consideration at the present time.

Soil and Climate.—Sainfoin is a perennial plant indigenous to dry chalky soils. Under suitable conditions the primary root descends to a great depth, and the plant is able to withstand the severest drought, being almost independent of surface moisture. Although sainfoin seems to prefer light soils containing a considerable percentage of lime, it is probably adaptable to a much wider range of conditions than is generally believed to be the case. Good crops are grown both on clays and loams in districts where the climate is dry and warm. Stagnant water, however, is fatal to the success of the crop. On the poorer and lighter classes of soil sainfoin contributes very materially to the success of subsequent crops. Barley, for instance, follows it with great advantage and on thin, dry soils unsuitable for turnips, rape and mustard may often be successfully grown after sainfoin. As a forage crop, specially adapted for sheep, it is of great importance in the South of England. It is sometimes sown instead of clover, more particularly in the Eastern Counties, where clover "sickness" is common.

Preparing the Seed-bed.—The cultural conditions best suited to the growth of sainfoin are practically the same as for lucerne. The soil should be clean and in good heart, and the subsoil readily penetrable by the tap-root.

Varieties, Seed and Method of Sowing.—There are two varieties in cultivation, the common sainfoin (*Onobrychis sativa*) and giant sainfoin (*Onobrychis sativa* var. *bifera*).

These flower during May and June, the common sainfoin being rather later than the giant variety. The common sainfoin is distinguished by its characteristic and somewhat meagre aftermath, which consists of long leaves, flowering stems being absent. The giant sainfoin is of more rapid and heavy growth; the second cutting produces flowering stems, and in consequence of this habit it is shorter lived. Giant sainfoin is best adapted for making into hay, while common sainfoin is the better for grazing. It must, therefore, be clearly borne in mind that the two varieties play distinct parts in husbandry. Giant sainfoin is more of the nature of a rotation plant, whereas common sainfoin should be regarded chiefly as a long-ley crop paying for special cultural and manurial treatment. On land that is not particularly suitable for growing a successful crop of sainfoin, the farmer would be well advised to sow the giant in preference to the common variety, as on land which is not able to hold common sainfoin for the usual term of years, the giant variety will yield more bulky crops in the time, and may be cut more often. Common sainfoin is usually at its best about the third year, but under suitable conditions it may be allowed to stand with profit for from five to seven years or even longer.

In the purchase of "seed" a guarantee as to variety should be required, and it is also of prime importance that attention be paid to the purity and vitality of the sample. The single-seeded fruit of sainfoin is irregularly half-moon shaped, with a flat and more or less spiny "wing" round the curve. Both sides are convex, with a coarse network of raised veins, provided, in some instances, with spiny projections. In good fresh samples the seed pods are fairly bright, and the colour is a dark straw or a light reddish-brown. Very dark and dull-looking "seeds" should be avoided, and also pale yellowish-green "seeds," the former denoting old age, the latter immaturity. The milled seed (that is, the seed removed from the husk or pod) and the entire fruit are both used by the farmer, but perhaps the latter is the more generally sown. The seed removed from the pod has a smooth surface, is kidney-shaped, and in good samples it is plump and yellowish-grey or light brown in colour outside and of a greenish tint inside. When black or shrivelled it has either been spoilt by bad harvesting or old age, and perhaps by a combination of both. Only seed harvested the previous summer or autumn should be sown.

As a rule, sainfoin is fairly free from foreign seeds—the most common impurity being burnet.

The "seeds" of burnet are in reality two-seeded fruits, and the difference in their shape and size, compared with the "seeds" of sainfoin, is well marked, yet, owing to both being wrinkled and of the same colour, unless the sample is closely scrutinized the burnet may be readily overlooked.

The best means of insuring a practically pure seed—and, consequently, if other things are equal, a clean crop—is to purchase milled seed only. The burnet, if present, will be seen at once, as it cannot be milled, and the only result of the milling is seen in the bruised and broken-winged appendages of the "seed."

As sainfoin ripens somewhat irregularly, and some difficulty is experienced in removing immature "seeds," the germination, when in the pod, is comparatively low, but there is no difficulty whatever in obtaining seeds showing a vitality varying from 75 to 85 per cent., and in milled seed 90 per cent. and over. The seed is drilled from February to May a little deeper than clover in rows 9 to 12 in. apart. It is usually sown at right angles to the corn crop already sown and after a root crop fed off with sheep. The cover crop should be sown thinly (about 1½ bushels per acre), in rows not less than 12 in. apart. It is especially important in the case of common sainfoin, which is intended to occupy the ground for a number of years, that the soil be free from weeds, and it may even be advisable in some cases to sow this variety without a covering crop. Four bushels per acre of unmilled seed or 56 lb. of milled seed is the customary rate of sowing. It is usual to grow sainfoin pure in the Eastern Counties, but on chalky soils in the South and West of England it is often used as a constituent of a mixture for temporary or permanent leys. A mixture of giant sainfoin, red clover and Italian rye grass makes excellent hay.

Manuring.—A dressing of very short dung, *i.e.* thoroughly rotted to destroy weeds, given during the first autumn, helps the plant in the early stages, and is, moreover, a protection against frost. If a crop is cut each year the land may receive further occasional dressings of farmyard manure with dressings of phosphatic and potassic manures in the intervening years, but as a rule dung should be used sparingly as a direct manure to this crop, although it may be freely applied to the preceding root crop.

Cutting the Crop for Hay.—Sainfoin grows to a height of 1½ to 2 feet, and produces numerous succulent branches with abundant foliage, bearing many-flowered spike-like clusters of flesh-coloured or rosy-red flowers; the compound pinnate leaves are sufficiently distinctive to aid one in recognising the plant.

It is important that cutting for hay should start directly flowering commences, as the plant is then at its best for feeding purposes, and each day's delay impairs both the quality of the hay and the future yield of the plant. It should be handled with great care, like lucerne and clover, to avoid breaking off the fine leaf; but it is not readily spoiled, if left alone unturned, even in the wettest weather. A yield

of 30 to 40 cwt. of hay is considered an average crop. In the case of giant sainfoin two crops of hay are often mown the first year after sowing, while seed is generally taken from the second crop in the second year, before ploughing up. Common sainfoin is usually cut for seed in its last year, before ploughing up, but a seed crop may be taken in any year except the year after sowing. When allowed to ripen for seed, cutting takes place in July or August, as soon as the lower seeds are fully ripe, and the crop is carefully dried before being stacked. It is desirable to cut the seed crop either early in the morning or late in the afternoon, when the plants are not too dry, to prevent shedding of mature seed. In a good season 25 to 30 bushels of seed in the husk may be obtained per acre.

If it be intended to keep the crop down for several years, it is usual to cut sainfoin for hay in the first year in order to encourage deep rooting; afterwards it may be mown or grazed as circumstances require. Whether as hay or as green forage it is an admirable food for all fattening and breeding stock, and is regarded as the best possible change for stock which may not be thriving on ordinary pastures.

Whitehall Place, London, S.W.,
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Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Apple Leaf-spot (*Sphaeropsis malorum*, Peck).

This disease is the cause of serious injury to the apple, pear and quince in the United States, where it has been recognised for a considerable time. It has only recently been reported as occurring in this country, although in all probability it has always been present, and has been passed over as being one of the other better-known fungi attacking our fruit-trees.

Description and Method of Attack.

The trunk, branches, leaves and fruit are attacked. On the trunk and branches the fungus causes a roughening of the bark, either in local patches, or extending for a considerable distance, destroying the bark and exposing the wood. When a branch is girdled, the portion above the wound dies. It also occurs on slender twigs.

The fungus causes a brown rot of the fruit, commencing as a small spot which usually spreads over the whole fruit. The fruit may be attacked while on the tree, but the fungus is most abundant on fallen fruit, where it produces spores in great abundance, which infect the tree the following season. In this country it has so far only been observed on apple and pear, more especially the former, and is most frequent on the leaves and young branches.

On the leaves the first indication of infection is the presence of minute, dark purple spots, which gradually increase in size, usually retaining a more or less circular outline, reaching up to half-an-inch in diameter. Very frequently neighbouring spots coalesce, forming irregularly shaped blotches. When old, the blotches are rusty-brown in colour, the central portion often being of a lead colour. Usually only after infected leaves have been lying on the ground for some time, very minute black points, the fruit of the fungus, are scattered over the central portion of the patches. Leaves that are infected fall early in the season, and if this defoliation is continued each season, as is almost certain to be the case unless preventive measures are taken, the trees become injured, and the fruit small and poor in quality. No very large canker wounds have been observed in this country, but young twigs are attacked, the infected areas being indicated by the bark becoming dry and much cracked, and the epidermis or skin being lifted up and torn into shreds. On such diseased areas the perithecia, or fruits

APPLE LEAF-SPOT.
(*Sphæropsis malorum*, Peck.)

FIG. 1.—Showing stages of growth of the leaf-spot fungus on apple leaves. Nat. size
„ 2.—Section of peritheoium. × 60.
„ 3.—Spores. × 400.

of the fungus, can be seen during the winter months, and it is mainly due to the spores produced on dead twigs that the leaves become infected in the spring. Scott and Rorer, who have investigated this disease in the United States, say that it occurs abundantly on dead twigs and branches in nearly every orchard, producing spores in enormous numbers. This is perhaps the most fertile source of infection for both fruit and foliage. In old orchards, particularly where pruning is neglected, the leaf-spot disease is much worse than in young orchards. The leaves of young trees adjacent to an old orchard become more spotted with the disease than those further removed.

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FIG. 4.—Early stage on a young branch.

Remedial Measures.

These observations clearly indicate that the prompt removal of dead branches and shoots is a matter of primary importance in checking the disease. The fallen diseased fruit should also be collected and destroyed. It is not at all certain that the spores on diseased fruit eaten by pigs or other animals are killed. Numerous spores are also produced on fallen, diseased leaves, a fact that it is well to remember, although it has been stated that the collection of such leaves is impracticable.

However carefully the trees may have been pruned, and fallen diseased material destroyed, many spores are certain to remain on and around the trees. To prevent these from infecting the young leaves the trees should be sprayed with Bordeaux mixture, half strength (*i.e.*, 6 lb. copper sulphate and 4 lb. quicklime to every 100 gallons of water. Copper sulphate of 98 per cent. purity should be used). A first spraying should be made about a week after the petals have fallen, and a second about a month later. Lime-sulphur wash as described in Leaflet No. 131 may be used instead of Bordeaux mixture in cases where that wash is considered dangerous.

NOTE.—The blotches formed on apple and pear leaves by the scab fungus, *Venturia inæqualis*, Aderh. (=*Fusicladium dendriticum*, Fckl.), are readily distinguished from those due to the fungus under consideration, by the ill-defined blotches being blackish or olive in colour, and by the spores not being produced in perithecia. A description of Apple Scab, together with remedial measures, is given in Leaflet No. 131.

Whitehall Place, London, S.W.,
November, 1913.

Leaflet No. 282.

BOARD OF AGRICULTURE AND FISHERIES.

Scheme for the Improvement of Live Stock.

A grant for the purpose of improving the live stock of England and Wales was made to the Board from the Development Fund in 1913. The amount available is approximately £40,000, and it is anticipated that similar grants will be made for some years to come. The grant is intended to enable the Board to assist groups of farmers, especially the smaller farmers, to obtain the use of high-class bulls, stallions and boars instead of the inferior sires which are very generally employed at present. The Board will also be enabled to pay one-half the expenses (up to a certain maximum) of associations of farmers who undertake to keep milking records of their cows.

In order to impress upon farmers the advantages of co-operation in securing the services of good sires, grants in respect of stallions and boars will be made only to clubs and societies. The same procedure will also be followed wherever possible in the case of bulls, but in districts where bull societies cannot be formed, grants will also be made to individual breeders who are willing to place approved bulls at the disposal of their neighbours.

Grants will be made preferably to societies specially formed to take advantage of the scheme, provided that they adopt rules which conform substantially to those issued by the Board, but grants may also be made to existing bull, stallion and boar societies on condition that their rules are amended where necessary. Registration of societies (under the Industrial and Provident Societies Act or the Friendly Societies Act) is not essential.

Preference will be given by the Board, in the assistance offered, to occupiers of agricultural holdings, which either do not exceed 100 acres in extent, or if exceeding 100 acres, are of an annual value for purposes of income tax not exceeding £100.

A further advantage to farmers under this scheme is that they will be able to obtain practical advice and assistance on questions relating to live stock from the Live Stock Officers, who have been appointed by the selected agricultural

institutions for the purpose of promoting the Live Stock Scheme in England and Wales. A list of these officers with their addresses and other particulars is given on pp. 4 to 6.

The following are some of the more important conditions on which the grants for the provision of bulls, stallions and boars, and the grants to milk recording societies will be made.

Grants for Bulls.

Grants for the provision of bulls will be made on the following conditions:—

(1.) No grant exceeding £12 per annum is to be made to any individual bull owner, or exceeding £15 per annum to any society in respect of any one bull.

(2.) Not more than four annual grants of £12 are to be made to any individual; and not more than five annual grants of £15 to any society for each approved bull provided by it.

(3.) Grants are only to be made to individuals when the Live Stock Officer in the area concerned is satisfied after full inquiry that it is not possible to form a bull club for a district in which the provision of a good bull is necessary.

(4.) No grant is to be made to any individual in respect of a bull previously owned by him unless the Live Stock Officer is satisfied that in return for the grant the bull can and will be made available for an appreciably greater number of cows belonging to small farmers than it now serves.

A society may provide a bull for the use of its members—

(*a*) By purchasing a bull and placing it in the custody of one of its members; or

(*b*) By arranging with an owner of a bull—whether he be a member of the society or not—to place a bull at the disposal of the society on terms agreed between them.

If a society arrange to purchase a bull, it will be necessary to provide, by means of contributions from members or donations to the society, sufficient capital to defray the cost of the purchase of the bull, and also an annual income sufficient to cover the insurance and keep of the bull, the salary of the secretary of the society, the general expenses of management, and sinking fund charges in respect of the

depreciation of the bull sufficient to provide for the replacement of the bull when necessary.

If a society arrange with an owner of a bull to place a bull at their disposal they must guarantee the service of not less than 25 cows belonging to their members.

The owner of a bull will be entitled under these circumstances (1) to a payment from the society of a sum not exceeding £12 as may be agreed upon, (2) to a fee of not less than 2*s.* 6*d.* for each cow served, and (3) to have not more than 15 of his own cows served by the bull.

If a society arrange for the provision of a bull in this manner, the grant of £15 made to them by the Board, together with a nominal subscription of say 1*s.* per member, would probably suffice to defray all expenses, as the owner of the bull and not the society will be responsible for the keep, insurance, and care, &c., of the animal.

Grants to Heavy Horse Societies.

Grants will be made on the following conditions to heavy horse stallion societies which hire stallions :—

(1.) No grants will be given to societies which hire stallions to travel at a fee exceeding £3 3*s.*

(2.) In no case will the grant to a society exceed £80 for each approved stallion provided by it, of which not more than £40 may be a direct grant, the remainder being utilised, if necessary, for "assisted nominations."

(3.) Except in the case of "assisted nominations" no reduction in the amount of the service fee usually charged is to be made by the societies receiving grants.

(4.) The stallions hired by societies receiving grants must be registered under the Board's scheme for the registration of stallions ; and the mares for which assisted nominations are given must be approved by the society as suitable for the purpose.

The value of an assisted nomination is not to exceed half the amount of the service fee.

Grants for Boars.

Grants will be made to societies only.

The amount of the grant for a boar will be £3 per annum,

A society may provide a boar for the use of its members :—

(*a*) By purchasing a boar and placing it in the custody of one of its members ; or

(*b*) By arranging with an owner of a boar—whether he be a member of the society or not—to place a boar at the disposal of the society on terms agreed between them.

If a society arrange to purchase a boar it will be necessary to provide, by means of contributions from members or donations to the society, sufficient capital to defray the cost of the purchase of the boar, and also an annual income sufficient to cover the insurance and keep of the boar, the salary of the secretary of the society, the general expenses of management, and sinking fund charges in respect of the depreciation of the boar sufficient to provide for the replacement of the boar when necessary.

If a society arrange with an owner of a boar to place a boar at their disposal, they must guarantee the service of not less than 20 sows belonging to their members.

The owner of a boar will be entitled, under these circumstances, (1) to a payment from the society of a sum not exceeding £3 per annum as may be agreed upon; (2) to a fee of not less than one shilling for each sow served; and (3) to have not more than 6 of his own sows served by the boar.

If a society arrange for the provision of a boar in this manner, the grant made to them by the Board, together with a nominal subscription of say 6*d.* per member, would probably suffice to defray all expenses, as the owner of the boar and not the society will be responsible for the keep, insurance and care, &c., of the animal.

Grants to Milk Recording Societies.

Grants will be made annually to societies whose members record the milk yields of their dairy cows not less frequently than once a week, and who employ a recorder to pay surprise visits to check, at least once every six weeks, the records taken. The amount of the grant will be half the expenses of the society up to £50 in respect of each whole-time recorder employed for every 20 herds in the possession of members of a society.

Further information as to milk recording societies, together with the text of the model rules and regulations issued by the Board, will be found in Leaflet No. 146 (*The Value of Records of the Milk Yield of Cows*).

List of Live Stock Officers.

The following is a list of the institutions, the counties served by them, and the Live Stock Officers to whom

enquiries for information as to the working of the Scheme in the respective provinces can be addressed :—

1. *Armstrong College.*—Cumberland, Durham, Northumberland, Westmorland.
Live Stock Officer—Mr. T. B. Schofield, Armstrong College, Newcastle-on-Tyne.

2. *Victoria University, Manchester.*—Lancashire and Cheshire.
Live Stock Officer—Mr. W. P. Middleton, Victoria University, Manchester.

3. *Leeds University.*— Yorkshire, East Riding, North Riding, West Riding.
Live Stock Officer—Mr. W. R. Crawford, Department of Agriculture, The University, Leeds.

4. *Harper Adams Agricultural College.*—Salop, Staffordshire, Warwick.
Live Stock Officer—Mr. W. Conwy Bell, Harper Adams Agricultural College, Newport, Salop.

5. *Midland Agricultural and Dairy College.*—Derby, Leicester, Lindsey (Lincs), Nottingham, Rutland.
Live Stock Officer—Mr. James Matthews, Midland Agricultural and Dairy College, Kingston, Derby.

6. *Cambridge University School of Agriculture.*—Bedfordshire, Cambridgeshire, Isle of Ely, Essex, Hertfordshire, Holland (Lincs), Kesteven (Lincs), Huntingdonshire, Norfolk, Northamptonshire, Soke of Peterborough, East Suffolk, West Suffolk.
Live Stock Officer—Mr. W. P. Crosland, School of Agriculture, Cambridge University.

7. *South Eastern Agricultural College.*—Kent, Surrey, East Sussex, West Sussex.
Live Stock Officer—Mr. H. E. Rudd, South Eastern Agricultural College, Wye, Kent.

8. *University College, Reading.*—Berkshire, Buckinghamshire, Dorset, Hampshire, Isle of Wight, Middlesex, Oxford.
Live Stock Officer—Mr. T. Hunter, University College, Reading.

9. *Bristol University.*—Gloucester, Hereford, Somerset, Wiltshire, Worcestershire.
Live Stock Officer—Mr. W. Nixon, Bristol University, Bristol.

10. *Seale Hayne Agricultural College.*—Devon, Cornwall.
Live Stock Officer—Mr. John Keddie, Seale Hayne Agricultural College, Newton Abbot, Devon.

11. *University College of Wales.*—Cardigan, Radnor, Brecon, Glamorgan, Carmarthen, Pembroke, Monmouth.

Live Stock Officer—Mr. D. D. Williams, University College of Wales, Aberystwyth.

12. *University College of North Wales.*—Anglesey, Carnarvon, Denbigh, Flint, Merioneth, Montgomery.

Live Stock Officer—Mr. R. N. Jones, University College of North Wales, Bangor.

A society or private individual desiring a grant under this scheme should address the application to the Live Stock Officer for the province in which the society or individual is located.

NOTE.—Detailed information as to the Board's scheme for improvement of live stock, and copies of the Board's model rules and regulations as to the award of grants to bull, boar, heavy horse and milk recording societies may be obtained, free of charge, on application to a Live Stock Officer or to the Secretary, Board of Agriculture and Fisheries, Craven House, Northumberland Avenue, London, W.C.

Whitehall Place, London, S.W.,
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Leaflet No. 283.*

BOARD OF AGRICULTURE AND FISHERIES.

Storage and Disposal of Apples and Pears.

It is believed that there is a very large number of gardens and small orchards in which apple and pear trees are to be found, the fruit of which is not put to its most profitable use by the owners. Much is wasted altogether, and more suffers in quality through the neglect of certain simple precautions.

Picking the Fruit.

In the first place many varieties of apples and pears are picked too soon. The reasons which make it sometimes necessary for a large grower to pick his fruit before it is ripe seldom apply in the case of the small grower. Early varieties can be picked before they are fully ripe and allowed to mature in a cool room. All late varieties, however, should be allowed to hang on the tree as long as possible. Such varieties are, among apples, Lane's Prince Albert, Newton Wonder, Wellington, Norfolk Beefing, Claygate Pearmain, Winter Pearmain or Duck's Bill Wannington, Sturmer, Alfriston, and Court Pendu Plat; and among pears, Catillac, Easter Beurré, Beurré Rance, Chaumontel, Beurré Diel, Duchesse d'Angoulême, and Doyenné du Comice.

Fruit of these and other late varieties should be allowed to remain on the trees till the fruit comes off easily when the apple or pear is lifted and given a slight twist. Care should be taken not to break off the young fruit buds at the base of the stalk, and of course fruit should never be gathered by shaking the tree or other violent method. Fruit which is to be kept must be gathered into a basket, preferably lined with some soft material, such as a piece of cloth, to prevent bruising. Diseased and damaged fruit should be placed in a separate basket.

Storing the Fruit.

The requirements for the proper storage of apples and pears are not the same. Apples require to be kept in a cool and rather moist place, where there is enough ventilation to prevent saturation. Pears require warm dry surroundings, but even under the most favourable conditions they will not keep long.

A few days after apples are put in store they begin to "sweat," and continue to do so for about three weeks. During this time there must be a free current of air round them which must not be too dry or they will begin to shrivel. After the "sweating" period is over this is not so important. Small growers who have only a few apples to

* This leaflet was previously issued as Special Leaflet No. 6.

keep will find that a good method is to wait till "sweating" is over and then pack them as closely as possible in a large earthenware jar or in a barrel. This should be covered with a piece of roofing slate or stone and stored in a cool shed or cellar, and the apples will keep plump and good as long as it is possible to keep the variety. For larger growers a shed or storehouse is required if no cool cellar is available, and in preparing a store the following points should be remembered:—

1. The fruit must be protected from frost, but subject to this precaution the temperature should be as low and equable as possible. A cave in a sand or chalk bank makes an excellent storehouse.

2. A moist atmosphere is necessary. The best kind of floor is the bare earth, which may be damped occasionally.

3. Ventilation is necessary, especially during the "sweating" period.

4. Apples easily absorb flavours from their surroundings. They should not be put on new wooden shelves, or on straw or hay, nor should any strong-smelling vegetable or other material be kept in the same room. They should be placed on slate shelves, or old seasoned wood may be used.

A useful apple store may be made by digging a large trench about 10 feet wide and as long as is required. The depth should be about two feet. A wall one brick thick and about four feet high should then be built on either side, and the soil that has been dug out should be heaped up against the outside of the wall. A roof of rough rafters thickly covered with thatch should be built over the top, and shelves can then be fitted inside on which the apples may be heaped. There should be a door at each end so arranged as to admit air and exclude light.

Apples should never be stored in an attic or top room of a dwelling house.

Grading of Apples and Pears.

If the fruit is to be consumed by the grower there is no advantage in selecting the fruit beyond the fact that it is better to eat the riper specimens first. If the fruit is to be sold it is very important that all the apples or pears offered for sale should be of similar size and quality. The practice of "topping" the consignment with a better class of fruit cannot be too severely condemned.

Packing of Apples and Pears for Market.

In packing apples and pears for consignment to market for sale by auction or on commission, it is important to remember that many of the purchasers are retail fruiterers and that the price which these buyers are prepared to pay,

depends to an appreciable extent on the manner in which the fruit is packed.

Three points are strongly insisted on by retail fruiterers. In the first place they desire to know the exact quantity they are purchasing. If they receive short weight they not only pay too high a price for the quantity received, but may be obliged to disappoint their customers. They desire in the second place, to be sure that the quality of the lots they purchase is the same throughout. If a package is "topped" with apples or pears of one description while those at the bottom of the package are of a different description, the purchaser may find that he has not enough of the kind required for his circle of customers and that he has a certain quantity that are of no use for his particular trade. Thirdly, they attach great importance to the application of initials or marks to each package so that they can select the goods consigned by growers who give full weight and who do not "top" their consignments.

The following recommendations are therefore offered for the consideration of growers who consign apples or pears to markets.

1. All the apples or pears contained in any receptacle offered for sale should be of similar size and quality.

2. The correct net weight should be indicated on each receptacle for the information of the buyers.

3. The initials of the consignor, or some mark by which the buyers can identify his packages, should be put on the receptacle.

Small growers are strongly advised to satisfy the local demand for fruit before consigning to large markets, as the risk of a glut and consequent unremunerative prices is thereby avoided.

Whitehall Place, London, S.W.,
September, 1914.
Revised, October, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 284.

BOARD OF AGRICULTURE AND FISHERIES.

Preservation of Outdoor Timber.

The destruction of wood by "rotting" depends on the work of living organisms, especially fungi. Moisture, air, and a suitable temperature are necessary conditions in the destructive growth of the lowly plants that induce decay in structural timber. Wood may be completely permeated with air, or it may be completely saturated with water and in either case show but little sign of decomposition. If, however, both water and air are present to a sufficient extent, the conditions of decomposition are at their best, and decay will proceed more or less rapidly, the rate depending on the temperature.

Methods of Treatment.

(1) *Surface Applications.*—A coat of paint laid upon wood assists in its preservation, because it excludes moisture, and, to some extent, air: but painting will only be effective if the wood has been thoroughly dried before the paint is laid on. Should the wood be wet to begin with, or imperfectly seasoned, painting may do more harm than good, because the moisture will be imprisoned and prevented from escaping, and conditions favourable to decay will be thereby created and maintained.

Besides oil paint, several other substances are used to waterproof wood, such as coal tar, and although the latter is objectionable from some points of view, it makes an excellent coat, which, being more or less elastic, admits of the contraction and expansion which the wood undergoes under the influence of changes of temperature. A coating that cracks readily is quite unsuitable, because through the openings thus formed water and the spores of fungi gain an entrance, and decay is rapidly set up.

(2) *Charring.*—At one time—and to some extent still—posts used for gates, fences and sheds were charred for one to two feet at the part that would come immediately above and below the surface of the ground. That part of a post is the point of weakness, because there decay begins and there it progresses most rapidly. The effects of charring are due to the destruction of wood to the depth of half an inch or so, the resins, gums, tannin, &c., which this wood contains being driven in front of the heat, until they saturate a layer which then acts as a protecting mantle to the deeper wood. To be effective, charring must proceed so far as to convert a considerable amount of wood into charcoal—a mere singeing or scorching of the wood will do more harm than good, as it will cause the wood to crack and

form openings for the entrance of fungi, but will not have proceeded so far as to saturate a layer of wood with resin, &c. The destruction of the surface wood is necessarily accompanied by a weakening of the post, and it is doubtful whether, on the whole, the charring of posts is a profitable process.

(3) *Impregnation with Creosote.*—Of the various methods that are practised for increasing the durability of timber, that which at present occupies the foremost place is the application of creosote. This substance owes its efficacy to the fact that it is a virulent plant poison, so that wood which contains a considerable quantity of creosote is more or less completely protected against the attack of decay-inducing organisms such as fungi. Wood, when in its natural state, holds certain substances (starch, proteins, &c.), which are the special food of fungi, but when these are saturated by creosote they are incapable of sustaining fungoid life. Creosote also acts as a preservative to some extent owing to the fact that it displaces air and water in the tissues of the wood, and these, as stated above, are essential to the process of decay.

It may be stated that many other substances besides creosote have been used as preservatives, such as copper sulphate, zinc chloride, and corrosive sublimate, but on account of their cost, or because they are poisonous to animals, or on account of their being easily washed out by rain, or because they corrode metal, they have all been supplanted more or less completely by creosote, except in countries where this substance is much dearer than in Britain.

The amount of creosote or other fluid that wood will absorb varies greatly with the species and other factors. Heartwood takes up much less than sapwood, damp wood takes up less than dry, slow-grown pine takes up less than fast-grown, and conifers as a rule take up less than broad-leaved trees. The wood that is subjected, more than any other, to the process of creosoting, is Baltic Yellow Deal, otherwise known as Baltic Red Wood, which is precisely the same species as Scotch Pine. This is the wood chiefly used for railway sleepers and also used for telegraph posts, so that enormous quantities have to be treated annually. As a rule the railway companies specify that each cubic foot shall contain one gallon of creosote, and for estate purposes this is as much as one can afford, since creosote now generally costs 4*d.* or more per gallon. By the absorption of a gallon, therefore, the cost of the wood is raised by 4*d.* or more per cubic foot, apart from considerations of labour and interest on plant. Certain soft woods, however, can absorb up to four gallons of creosote per cubic foot, and many will

take up two gallons. Apart from all question of cost, there is little to be gained by exceeding one gallon, for in the course of time the excess, beyond what the wood can really hold, will simply flow out into the soil and be lost.

The great value of creosoting for estate purposes consists in this, that it so prolongs the "life" of low-class timber as to enable such material to be used for fencing and other purposes. Spruce and Scotch Pine thinnings, for instance, which will only last for three or four years if used as posts in their natural state, will, if creosoted, remain serviceable for from twelve to fifteen years. Larch thinnings, although more durable than spruce or pine, should also be creosoted before being used as posts. There are several broad-leaved species which, on many estates, furnish large quantities of small wood and which, in their natural state, are not worth the labour of using for fencing purposes, but are thoroughly serviceable when creosoted. To this group belong Alder, Beech, Hornbeam, Sycamore, Ash, Birch, and Poplar. Even coppice oak has little durability when in its natural state, and ought always to be creosoted before use.

Pressure Plant.

On a large scale creosote is usually applied under pressure, and this process entails the provision of a somewhat costly plant. But on account of the thoroughness and rapidity with which the impregnation is carried out, the outlay on a pressure plant is justified where a large amount of timber has to be dealt with, and such plants are now to be found on many estates.

Soakage Plant.

(a) *Hot.*—On small estates the cost of erecting and working a pressure creosoting plant is prohibitive, but excellent results can be obtained by simpler methods. Many make use of an iron tank erected on brickwork in such a way that the creosote can be raised to near the boiling-point by means of a fire underneath the tank. Immersion in such hot creosote for eight or nine hours will confer on wood most of the benefits got from two or three hours' treatment in a pressure chamber. The tank should be protected against rain by means of a light roof, and precautions must be taken against fire, creosote being highly inflammable.

(b) *Cold.*—Even a tank where the creosote can be heated is, however, a more elaborate arrangement than is necessary upon a farm or quite small estate. While heating assists in driving the creosote into the wood, cold creosote will enter almost as far, if more time be allowed. Even where only a few hundred posts (stobs) are being used, it pays well, unless the wood is mature larch or oak, to provide a tank in which the lower part of each post can be treated. Remembering that the upper part of the post will, in its untreated

condition, usually last for many years, it is the lower part only that requires treatment; the posts may, therefore, be set vertically in the tank, about one-third of their length being immersed in the liquid. If it is desired to treat gates, hurdles, and rails, the tank must be proportionately longer and deeper, but a very simple arrangement suffices to treat the lower half of a fencing post. An ordinary intermediate fencing post is generally placed in the ground to a depth, at most, of about 2 feet, so that the part "between wind and water" will be treated if it is immersed in creosote to a depth of 2½ feet. A suitable receptacle for the creosote is a galvanised iron tank 8 feet long, 2½ feet wide, and 3 feet deep. This will hold 150 to 200 ordinary posts placed vertically, and will when required also admit of about a dozen straining posts being laid horizontally in it. When the posts are set in the trough the liquid is fairly rapidly absorbed, and as the level falls more creosote must be added. The posts should stand in the liquid for three or four weeks, and if a fresh lot is inserted without loss of time it is evident that two to three thousand can be passed through in a year. Four ordinary posts will absorb about a gallon of creosote, so that the cost of material for each post is *only* about one penny, and the labour and interest on the cost of the trough are practically negligible. It is desirable that the process should be conducted away from buildings, but a light roof should be provided to keep off the rain. Needless to say, the drier the wood to start with the better will be the results. As a 40-gallon barrel of creosote is rather inconvenient to handle, it is an advantage to construct a small platform at one end of the tank, on to which the barrels may be unloaded from the cart. One or two sheets of corrugated iron should be placed in such a position that when the posts are removed from the tank and set up to drip, the creosote that runs off shall flow back into the tank.

It is surprising how high creosote will rise in certain kinds of wood, and it is not unusual to see the material showing on the upper surface of a five-foot post when not more than two feet are immersed in the creosote.

Many miscellaneous articles which come in contact with the soil, such as sheep troughs and poultry coops, last much longer if creosoted.

Whitehall Place, London, S.W.,
May, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 285.

BOARD OF AGRICULTURE AND FISHERIES.

Bacon Curing on the Farm.

In rural districts there has of late years been a great decline in the home-curing of bacon owing to the more extensive production of mild-cured bacon in factories, for which the general public have acquired a taste.

Home-cured bacon and hams of the highest quality can be produced with suitable management, and it would undoubtedly be an economical proceeding for many small farmers and cottagers to undertake the curing of their own bacon.

Weight of Bacon Pigs.

The best pigs to feed for bacon are those long in the back, and with light shoulders. For factory purposes, buyers seldom purchase bacon hogs weighing more than from 160 to 200 lb. Farmers, on the other hand, who want to produce bacon for home consumption, generally allow their pigs to attain a weight of from 280 to 320 lb., and in many instances these weights are exceeded, especially in the case of old fat sows. Economy is sometimes effected when the latter are fattened in order to obtain an abundant supply of lard for domestic purposes, but where the object is simply to produce good quality bacon, farmers would do better to raise hogs for bacon scaling not more than 240 lb. The nature and the quantity of the food largely determine the rate of growth, but with well-bred pigs there should usually be an increase of 20 lb. per month. A pig eight months old ought, therefore, to yield a carcass of 160 lb., and this is perhaps the most esteemed weight on the market.

Time of Year.

The home-curing of bacon is best performed during the autumn and winter months, from November to February, and although mild-curing may be satisfactorily effected during the summer months, where special facilities are available, yet at that time of year the disadvantages of the warm weather and the prevalence of flies call for the exercise of additional care.

Slaughtering.

A bacon hog should be fasted for twenty-four hours before killing, but may be allowed to take water freely. It should not be allowed to get into a heated or excited state, as the meat is then believed to be more difficult to cure, and less mild and palatable in flavour. As a rule, the local butcher is called in to do the slaughtering, but many farm hands are quite experienced enough to be trusted with it. A butcher will usually charge from 2*s.* 6*d.* to 3*s.* 6*d.* for one hog, the charge including two journeys, one visit being for the actual slaughtering and the other for cutting up.

If the carcass is to be scalded after killing, a large tub or tank will be required, as well as a good supply of boiling water; and in order to suspend the carcass for cooling, a pulley and hoist should be arranged in some cool, airy place. In order that the carcass shall present the best possible appearance, it is essential that the flesh or skin should not be bruised or marred in any way; any such damage, moreover, may prove detrimental to the chances of perfect curing.

Preparing the Carcass.

The pig should be ready for scalding or singeing about four minutes after killing. In the south and west it is the general practice to scald porkers and to singe bacon hogs, but in many other districts it is customary to scald bacon hogs. Some curers are of opinion that scalding makes the skin rather flabby, and so tends to interfere with the curing process.

In many cases a perfectly clean, white skin is preferred, and this can only be ensured by very careful scalding so that the surface of the skin does not lose its clearness and become browned through the use of excessively hot water. For an old coarse-skinned hog, the scald should consist of three parts of boiling water to one of cold; while for young pigs the use of two parts of boiling water to one of cold is preferable. Any blunt instrument, such as the back of a knife, will serve to scrape off the hairs, and every part of the carcass should be thoroughly cleaned in this way; the scraping should be done as expeditiously as possible or the hair will be difficult to dislodge.

For singeing, a dry, shallow bed of clean wheat straw is prepared, upon which the carcass is laid, small wisps of straw being placed between the hind and the fore legs, and a thin covering over the exposed parts of the body. When the straw is set alight at the windward side the hairs will be quickly charred, and can then be readily brushed off with a birch broom; having completed one side, the carcass should then be turned over to receive similar treatment.

Care must be taken, in singeing, to avoid blistering the skin by applying too great a heat.

After scalding, the carcass is hoisted to a beam by means of a short stick placed between the hind legs. The belly is then ripped from nearly between the forelegs to just below the tail, and the internal organs are removed, and placed on one side for further use. The toes and nails are also removed at the time the pig is opened. The liver, lungs, and heart, as well as the minor organs surrounding them, may generally be removed intact.

The carcass should next be washed and wiped dry, both inside and out, a short stick should be inserted to keep the ribs apart, and a stone or stick put in the mouth to keep it open; thus it may be left to cool, the leaf lard being first taken out for rendering as soon as the interior has been properly cleansed. The carcass should be allowed to cool for at least one day before being cut up.

When thoroughly stiff and cool, the head should first be removed and the carcass cut into two sides by splitting down the back from the tail to the neck with a chopper. The methods of cutting up a pig vary according to locality. In the south it is usual to cut out the belly piece first; in Cumberland the spine is generally removed in one piece, accompanied by the breast bone and the two small ribs nearest the shoulder; the old Ayrshire curers split the carcass down the middle and afterwards hung up the two sides by hooks thrust through the gammon hocks. In the ordinary way, when the head has been removed, the backbone should be cut out, and removed very carefully so as not to take too great a proportion of lean meat; if thick chines are taken, much of the lean meat of the back is removed at the same time, so that a fat rasher is produced as compared with that from a medium pig, where there is a fair proportion of fat and lean. Afterwards the hocks and forearms may be removed, and also the spare ribs, if the pig is a large one. The fillets, or "lean meats," are cut from the flitches, and the ham cut out at about the third joint from the tail. From the head can be cut jowls or cheeks, eye pieces, tongue, ears, and nose pieces. These pieces, together with the heart, liver, and lights, can be made into brawn, collared head, potted pork and tongue, etc. The leaf and other spare fat can be rendered into lard, while sausages can be made from other spare parts. When well cleaned and boiled the stomach and the chitterlings can be used as tripe, while the spare ribs may be roasted, and the lean meats used for pies.

Curing.

The curing of bacon should preferably be conducted in a moist atmosphere at a temperature of from 40° to 42° F. The meat may be either dry-salted or pickled, and although the

former is certainly the more convenient and less troublesome method, a very large number of curers have now adopted the use of the pickle pump or syringe for injecting a suitable preparation into the meat. The carcass must always be thoroughly drained of blood before any attempt is made to salt or pickle it, the large blood veins being carefully removed beforehand and the carcass neatly trimmed.

As regards the different recipes for curing, it appears that many farmers and cottagers cherish secret methods, known only to themselves, and handed down from generation to generation. It is difficult to ascertain what these recipes are. One, for example, intended for sweet-cured hams, is as follows :—1 quart strong beer, ½ lb. black treacle, ½ lb. brown sugar, 2 oz. juniper berries, 1 oz. coriander seeds, 1 oz. pepper-corns, 1 oz. allspice, 1 oz. cloves, 1 oz. saltpetre, ½ oz. sal-prunella, and two or three onions. The spices are ground finely and the whole preparation boiled for thirty minutes; when cold it is poured over the ham, and the latter is pickled and turned every day for about three weeks afterwards. It is preferable, however, to use spices whole, placing them in a muslin bag before boiling.

A good method of curing bacon, and one which is practised with success in Lancashire, is the following :—

The side is cut into three pieces—ham, flitch, and shoulder. The rind of each is well rubbed with fine, dry salt, the pieces being then placed on a stone slab sprinkled with salt. The curing of the flitch is effected by—

1. Applying a thin covering of salt.
2. A slight sprinkling of saltpetre.
3. A sprinkling of granulated sugar (a single handful).
4. A final sprinkling of salt.

The flitch is then left for four days, when the rind is again rubbed with salt, a very thin layer of which is also sprinkled over the surface.

In eight to ten days from the commencement of curing, the salt is brushed from the flitch, which is then hung up to dry for ten to fourteen days, and finally covered with fine muslin, and stored in a cool, dry room.

The ham and shoulder are treated in the same way as the flitch, but are left "in salt" fourteen to twenty-one days, and sprinkled with salt at intervals of four or five days. The ham, especially, should be disturbed as little as possible.

For a carcass weighing 280 lb. the approximate amounts required are :—

Fine, dry salt	20–24 lb.
Saltpetre	1–1½ lb.
Sugar	2½–3 lb.

The Hampshire System.—In the Hampshire process the hams and flitches are laid on a cool stone floor, sprinkled with salt, and left for eight or ten hours; after allowing the brine to run off freely by turning them on edge for a time, the skin side of the flitch is rubbed thoroughly with salt, the shanks being stopped with salt and saltpetre. Salt, saltpetre, bay salt, pepper, and sugar all enter into this process. Some curers put the sides into a "silt" of strong brine, after which they are taken out and dry-salted on a bench for from fourteen to twenty-one days, according to the size of the flitches. The flitches are stacked on a cool stone floor, rind downwards, one on the top of the other, and at the end of about three days their positions are reversed, the bottom flitch being brought to the top and the top to the bottom. This process is repeated at intervals about six times, and subsequently all the stale briny salt is rubbed off, and each flitch is well covered with fresh bran or sawdust, after which it is hung in the drying loft for two weeks or more. Much Hampshire bacon is cured on old-fashioned rule-of-thumb methods, the curer using his own discretion as to the quantities of ingredients.

A Buckinghamshire Cure.—A Buckinghamshire method of curing bacon is as follows:—Each flitch is well rubbed with 2 oz. of finely pulverised saltpetre, special care being taken to apply a larger quantity to the parts where the ham and shoulder have been removed. A mixture of 7 lb. of salt and 1¼ lb. of coarse moist sugar is then heated in a frying-pan, and the flitches are rubbed all over with this hot mixture; they are then placed one on the other in a salting pan, and are well basted and rubbed with the brine that commences to form. This treatment is continued for some time, and the sides are meanwhile turned twice a week; at the end of four weeks they will be ready for smoking. The two hams are cured simultaneously with the flitches, and are hung on nails or put on a bacon rack in the kitchen, till they are quite dry externally, and have the remaining pickle crystallised on the surface; they are then hung in the chimney or smoke loft to undergo the action of the smoke from the wood fires.

The Cumberland System.—A typical Cumberland recipe consists of 4 stones of salt, 4 to 8 lb. pure Demerara sugar, and from 1½ to 2 lb. of saltpetre. It is customary to rub the hams thoroughly with the salt at intervals of four or five days. The other ingredients are added after the second application of the salt, and the bacon is smoked after the lapse of another week.

Pickling Bacon.

A really good quality mild-cured bacon can never be obtained unless the brine or pickle is injected into the side with

the brine or force pump, after which operation all that is necessary in order to complete the pickling is a sprinkling of dry salt, the hams being turned at intervals for about two or three weeks, when they will be ready for smoking.

Pickling ensures that the meat is salted more uniformly than in the case of dry-salting. A good pickle for the purpose is composed of 1 lb. of saltpetre, 1 lb. of brown sugar or 1 pint of treacle, and 11 lb. of coarse salt, with water to make up 4 gallons. This pickle is suitable for hams. For bacon, the following ingredients may be boiled together and the preparation afterwards skimmed quite clear before using :—14 lb. of salt, 1¼ lb. of saltpetre, and 1½ lb. of cane sugar, with water to make up 3 gallons. A salinometer, which is a modified form of hydrometer, is necessary when using a pickle for bacon ; otherwise it is impossible to tell whether the mixture is at the right strength.

In curing hams, the needle point of the pickle pump should be inserted in all the fleshy parts of the meat, and the pickle injected, especially into that portion of the meat in close proximity to the bone, as it is here that there is most risk of decomposition arising. The hams should be allowed to soak in the pickle for about forty-eight hours, and then all the liquid must be squeezed out by means of thumb pressure, repeated in the direction of the veins. A coarse, dry cloth is then used to dry the hams thoroughly, and they are afterwards placed in a fresh pickle or laid rind downwards on a cool stone floor and covered with a layer of salt from ½ to 1 inch thick.

Hams may also be cured by steeping them in the pickle contained in a tank. After leaving them in the pickle for a day they should be taken out and the veins squeezed, as already advised; the hams should then be wiped dry and placed in a fresh lot of pickle and left there for two or three weeks, according to whether a mild or full-flavoured ham is required. Salt is then sprinkled over the cut surfaces and the hams are thickly covered with salt. For mild-cured bacon pigs, weighing from 140 to 180 lb., nine days in salt are required ; for pigs scaling 180 to 200 lb., eleven days ; and pigs weighing 200 to 220 lb., twelve days. For bacon that is required to be kept for a year or more, at least twenty-one days in salt would be required, and for ordinary dried bacon, smoking will be necessary after the sides have been washed free from salt.

Smoking.

In the ordinary way hams and flitches will be "pale-dried" in about three days in a dark room at a temperature of about

85° F. While green or unsmoked bacon is preferred in the north, south country consumers like smoked bacon best. Some of the old smoke lofts for bacon in old-fashioned farm-house kitchens in the south are still in use.

The modern method of smoking bacon, however, is much more speedy and effective. Any convenient outhouse in which the escape of smoke can be regulated by an efficient ventilator may be utilised for the purpose, the chief thing to guard against being the risk of fire. An earthen floor may be used, but a cement floor is best. The flitches and hams should be thoroughly dried in the open air during dry, windy weather, before smoking. The floor of the out-house or smoke-room should be covered with a layer of several inches of clean, dry wheat straw, on the top of which is placed a layer of oak sawdust 3 or 4 inches deep. If the latter is damp there will be some difficulty in getting it to burn properly. Before smoking, it is usual to dust the hams and flitches with pea meal, so as to impart to them that rich brown tint so characteristic of Wiltshire bacon.

After smoking, the hams are packed in thin calico or flour bags and hung up in a dry kitchen, but care must be taken that they are not kept near a hot ceiling, or partial decomposition may result. The custom still prevails in many north country farm-houses of keeping flitches and hams in meal, and some very excellent green bacon is often stored in this way.

Whitehall Place, S.W.,
December, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 286.

BOARD OF AGRICULTURE AND FISHERIES.

Narcissus Flies.

Of the various animal pests attacking the bulbs of Narcissi and related plants none are more injurious than the two Narcissus flies, *Merodon equestris* F. and *Eumerus strigatus* Fln. The former, often known as "the Large Narcissus Fly," has been recorded in this country since 1869, and is now widely distributed in England and Wales, while it also occurs in many parts of Scotland and in Ireland. It is generally supposed to have been brought to England from the Continent, probably from Holland, but in the opinion of at least one authority it is considered to be native, and only to have become noticeable as a pest when daffodil growing became general.

The second species, *Eumerus strigatus*, which may be known as "the Small Narcissus Fly," has only recently proved to be a serious pest to Narcissi. Though widely distributed on the Continent, it has usually been considered a scarce insect in this country; it has now, however, been recorded from several bulb-growing centres, and, as it is an exceedingly destructive insect, is likely to prove as serious a pest even as *Merodon*.

THE LARGE NARCISSUS FLY.

The adult *Merodon equestris* (Fig. 1) is a large fly measuring about half-an-inch in length. The body is stout and very hairy, and the general shape is that of a small humble bee. In colour the individual insects vary considerably. The ground colour is black, but the hairs may be grey, yellow or brown, and the varieties, therefore, differ considerably from each other in appearance. The more common form is dark brown or black, banded with yellow or grey, when the fly much resembles a humble bee; in another form these bands are inconspicuous or absent, and the insect is very like a honey bee or a drone fly (*Eristalis*). Owing to this variation in appearance, bees, humble bees, and drone flies are frequently considered to be Narcissus flies, and it may therefore be well to give the simple distinguishing characters. From either honey or humble bees *Merodon* may at once be

distinguished by the fact that it possesses only two wings, whereas bees always have four. From drone flies it may be known by being more hairy and by possessing a broad tooth-like process on the underside of the femora (thighs) of the hind legs, near the tip (Fig. 2, *a*). If a male it will also possess a sharp spur at the end of the tibia of the hind leg (Fig. 2, *b*). The Small Narcissus Fly has little resemblance to *Merodon* and is only about half the size (cf. Figs. 1 and 6), and the two are not likely to be confused.

The egg of *Merodon* is minute, but visible to the naked eye; it is oval in shape and white in colour.

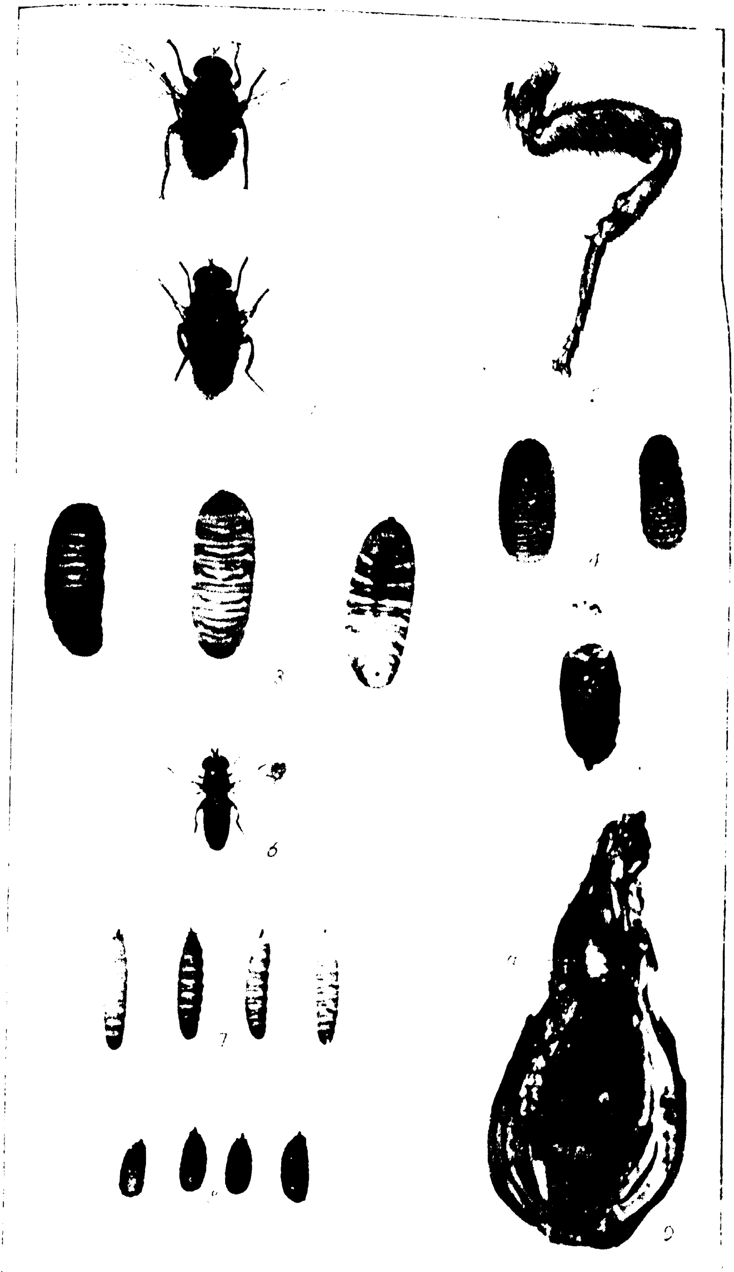
The *larva* is a legless grub of a whitish or yellowish colour, and when full grown measures from ½–¾ inch in length. Its general shape may be seen from Fig. 3. When first removed from the bulb it appears to be almost equally rounded at each end, but the hind end may be distinguished by a black horny projection,* carrying breathing pores, which is almost withdrawn into the body. If the larva is left untouched for a minute or two it extends itself so that the front end becomes more pointed, and on its underside the mouth may be seen, with two minute black hooks representing the jaws. The black structure at the tail end becomes more obvious and a minute projection may be seen on each side. The larva of *Merodon* when full grown is not likely to be confused with other larvæ to be found in bulbs, but when young it might be confused with that of the Small Narcissus Fly, and the essential differences will be found under that species (page 4).

The pupa of *Merodon* (Figs. 4 and 5) is enveloped in a hard, horny skin, which is really the final skin of the larva; the black terminal projection can still be seen.

Life History.

The flies are found in spring and early summer flying actively in the sunshine. They then pair, and eggs are laid at or near the base of the leaves of Narcissi, or on the necks of the bulbs themselves when these are exposed. The larvæ which hatch from these eggs, according to some authorities, enter between the scales at the neck of the bulb and bore into the interior. Other authorities state that the larvæ pass down outside to the base of the bulb and then enter. Certainly the basal ring (which bears the rootlets) of bulbs which contain larvæ is frequently incomplete or damaged. Once inside the bulb the larvæ feed steadily, consuming the

* In the illustration the heads of the larvæ are directed downwards, the hind ends upwards.



MERODON EQUESTRIS.—1. Adult fly × 1½; 2. Hind leg × 5, to show tooth (*a*) on femur, and spur (*b*) on tibia; 3. Full grown larva × 1½; 4. Pupæ × 1½; 5. Pupal skin from which fly has emerged; 9. Narcissus bulb cut in half to show *Merodon* larva in neck of bulb (*a*).
EUMERUS STRIGATUS.—6. Adult fly × 1½; 7. Full grown larvæ × 1½; 8. Pupæ × 1½.
In 3, 4, 7 and 8 the heads of the larvæ or pupæ are pointing downwards.

whole interior until full grown, when they are often found in the hollowed-out neck of the bulb (Fig. 9, *a*).

The length of life of the larvæ is still the subject of dispute. It seems probable that the majority feed rapidly and are full fed in the course of the autumn, when some may pupate, though most appear to remain in the larval state until early spring and then become pupæ. It is also said that larvæ may take two years to become full-grown, a view which is based on the fact that young larvæ have been found in the early months of the year. Since, however, flies have been observed as late as July it is probable that these small larvæ would still have time to complete their feeding in the spring and produce flies late in the season. As a rule only one larva occurs in each bulb, but two and sometimes three larvæ are occasionally found. The larvæ are able to migrate from one bulb to another in the soil.

The pupa is sometime formed in the bulb, but more frequently in the soil.

Plants Attacked.

The bulbs attacked include the Narcissus, Hyacinth, Tulip*, Amaryllis, Habranthus, Vallota, Galtonia, Scylla, and Leucojum. As regards Narcissus it has been considered by a leading grower and authority on *Merodon* that the hard bulbs of the *N. maximus* and *N. spurius* type are least attacked, while the most susceptible are the *N. poeticus* and *N. Leedsi* varieties, and, further, that varieties with coloured cups are more susceptible than those without.

Nature of Injury.

The interior of the bulb is hollowed out, a wet mass of frass and decayed matter only remaining (Fig. 9). The decay due to *Merodon*, however, does not cause such a complete breakdown of the bulb as in the case of an attack by *Eumerus*.

When the larvæ are large the infested bulbs can be detected after a little experience by gently pressing near the neck with the fingers—sound bulbs being hard, and infested bulbs less resistant. When the larvæ are young it is much more difficult to be sure of their presence, but it is said that any bulb in which the basal ring is incomplete or damaged should be regarded with suspicion.

Treatment.

No complete remedy is known. The following methods have given good results, but, in making a choice, the nature of the case to be treated must be considered :—

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* The Tulip is always mentioned as one of the food plants of *Merodon*, but it appears to be rarely attacked, and in badly infested localities Tulips are often quite undamaged.

(1) When a number of bulbs in a row fail to appear in the spring, those which have missed should be searched for and destroyed.

(2) Bulbs should be lifted in summer, and all found to be infected should be destroyed.

(3) Bulbs may be steeped in water for from 24 to 48 hours. The water should be just warm, and, if possible, should not be allowed to become very cold, as it is stated that the bulbs occasionally suffer damage through being chilled. The steeping seems to make the bulb swell so that the larvæ are forced out, or perhaps to some extent "drowned out," though they can live for many days when immersed. This treatment has been found very effective, though a few larvæ are always missed.

(4) Netting the flies with a butterfly net has been found quite successful in gardens.

The Small Narcissus Fly.

The adult *Eumerus strigatus* is a fly about ¼ in. in length, the general appearance and shape of which is shown in the plate (Fig. 6). The general colour is black, but between the wings the thorax shows greenish metallic reflections, and there are white crescent-shaped marks along the sides of the abdomen, and a white line on each side of the thorax. The femora (thighs) of the hind legs are thickened, and are usually rather conspicuous.

The larva of *Eumerus* is a legless grub of a yellowish white colour, though it is usually stained dark brown by the decaying material in which it lives. When full grown it measures from ¼ in. to ⅓ in. in length. Its most marked characteristic is the possession at the tail end of a conspicuous chestnut-coloured horny tubercle, on each side of which is a pointed projection which is also easily seen (Fig. 7). These characters will serve to distinguish the *Eumerus* larva from that of *Merodon* at all ages, and from any other larvæ which might be found in bulbs. The fact that there are always a number of larvæ (usually 10 to 30) in attacked bulbs will also help to determine the presence of this species, but it must be remembered that both *Eumerus* and *Merodon* may be found in the same bulb.

The pupa (Fig. 8) is barely ¼ in. in length and is enclosed in a hard, horny skin of a whitish colour. As in the case of *Merodon*, this skin is really the last skin of the larva and shows the marked characteristics mentioned above. It is

usually found under the outer scales of the bulb, or in the neck, but may also occur in its interior or in the earth near the bulb.

Life History.

The life history has not yet been completely traced. The flies appear in May and June and are supposed to lay eggs near the base of the Narcissus leaves. The eggs hatch and the larvæ burrow into the necks of the bulbs. Of these larvæ, some appear to feed rapidly and are full grown in August, when they pupate and produce flies in September and October. The remaining larvæ become full grown in the autumn and as a rule remain as larvæ until early spring, when they pupate, producing flies in late spring and early summer. What becomes of the flies which emerge in autumn is not yet known, but they do not appear to live long and almost certainly do not hibernate. Specimens have been observed pairing in September and October. In preliminary experiments carried out in 1913, bulbs in the ground and also uncovered in the store were exposed to flies of the second brood but were in no case attacked. The flies themselves may be found flying in the sunshine over the Narcissus beds; they do not seem to go far from the plot from which they have emerged, and fly close to the ground, often settling on the ground. They were not observed to frequent flowers.

Plants Attacked.

The plants attacked are the Narcissus, Hyacinth, Onion and Shallot (the two latter only on the Continent).

Nature of Damage.

In an advanced stage of the attack the interior of the bulb is entirely destroyed, and is full of a semi-liquid decaying mass. The attack seems to begin at the neck, and in mild cases the larvæ are found in the neck or under the scales at one side. The presence of many larvæ and the complete decay produced distinguishes the damage done by *Eumerus* from that done by *Merodon*.

Remedies.

Until the life history is known little can be suggested in regard to remedial measures. The destruction of affected bulbs when lifting is obviously indicated, and, since the decay produced is rapid, there is little difficulty in recognising them. Early lifting also seems desirable to destroy the larvæ before the emergence of the second brood.

OTHER FLIES.

The larvæ of several other flies are frequently found in bulbs decaying from any cause, but they do not appear ever to start an attack on a healthy bulb.

The commonest species are *Lonchæa chorea*, of which the fly resembles a small "blue-bottle"; and species of *Scatopse* and *Sciara*, these being small gnat-like insects.

Whitehall Place,
London, S.W.,
July, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 256 *dealing with the fungus "Fusarium bulbigenum" which affects Narcissus bulbs can be obtained from the same address, post free.*

BOARD OF AGRICULTURE AND FISHERIES.

DISEASES OF PEAS.

Powdery Mildew (*Erysiphe polygoni*, D. C.).

During a comparatively dry, bright season, the leaves of peas often show sickly yellowish-green blotches, which gradually increase in size until the whole of the foliage changes to a yellow colour and soon wilts and dries, though the leaflets as a rule do not fall. If the under-surface of a leaf, just beginning to show yellow patches, is carefully examined, the discoloured patches will be seen to be covered with a delicate whitish mildew, which gradually spreads over the entire surface, or even over the upper surface as well. When badly attacked a row of peas presents the appearance of having been whitewashed—leaves, stems and pods being equally covered with the mildew. In such cases the plants soon die outright, and in every instance the injury caused to the foliage affects the crop, the injury being in proportion to the amount of mildew present.

When examined under a microscope, the mildew is seen to consist of myriads of reproductive bodies (conidia), which are produced in chains, but soon become free from each other and form a dense white mass on the surface of the leaf, suggesting the idea that it had been sprinkled with flour. These conidia are summer-spores, which are capable of germination at the moment of maturity; they are scattered by wind, rain, insects, &c., and in this way spread the disease. Later in the season, when the infected plants are dying, a second form of fruit, known as winter-fruit, is produced from the same vegetative portion of the fungus (mycelium) which had previously given origin to the summer-fruit. The winter-fruit first appears in the form of minute yellow balls which eventually become dark brown or blackish, and are often present in myriads on the dead leaves. These spherical winter-fruits enclose spores or reproductive bodies. They remain unchanged until the following spring, when they decay and the spores are liberated. These spores infect young pea plants and give origin to the vegetative stage of the fungus (mycelium) which first produces the crop of summer-spores.

Powdery mildew also attacks various kinds of vetches, both cultivated and wild, and several of our commonest weeds belonging to widely separated families of plants.

Methods of Control.—Spraying is practically ineffective unless begun sufficiently early—it should be begun before

the disease appears in June or July, especially if the weather is dry and hot.

Liver of sulphur, used at a strength of 1 oz. in 4 gallons of water, is preferable to Bordeaux mixture for this disease. As the disease is not apparently carried in the seed, the infection must be derived from some outside source, such as from diseased pea straw, or weeds capable of harbouring the parasite. The straw should, therefore, be burnt and weeds kept down.

Pea Mildew (*Peronospora viciæ*, De Bary).

This mildew is liable to be confounded, by the casual observer, with the Powdery Mildew described above, but belongs to a totally different group of fungi and requires different treatment. The leaves first become covered with a delicate white mould, which soon changes to a pale pinkish-grey colour, and may pass unnoticed until its presence is indicated by the wilting and yellowing of the leaves. The powdery appearance of the mould, so characteristic of Powdery Mildew, is entirely absent, and, inspected with a good pocket-lens, the mildew is seen to consist of myriads of upright stems, which bear numerous branches at the tip, the tip of each branchlet bearing a single summer-spore (conidium). It is these summer-spores, dispersed by various agents, that spread the disease during the growing season. The winter-spores are produced on the vegetative form of the fungus (mycelium) which is present in the tissues of the dead leaves, and cannot be seen from the surface. These winter-spores, as usual, remain in a resting or unchanged condition until the following spring, when they germinate and infect peas and allied plants.

Pea Mildew also attacks both wild and cultivated vetches, and many wild plants belonging to the pea family.

Methods of Control.—The first infection in spring can only be due to winter-spores, and hence the necessity for destroying all diseased material—burning is the only certain method of accomplishing this object, as the winter-spores pass through the intestinal canal of an animal without injury. Spring infection is often due to fragments of diseased leaves falling to the ground, where they decay and liberate the winter-spores, which remain on the ground until the following spring. Rotation of crops would in this instance be desirable.

When the disease is present, spraying with half-strength Bordeaux mixture* should be resorted to. Liver of sulphur is much less satisfactory in its action on the mildews proper.

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* 6 lb. copper sulphate or bluestone (98 per cent. pure) and 3 lb. quick-lime to 100 gallons of water.

Pea Rust (*Uromyces fabœ*, De Bary).

During certain years, especially when the weather has been hot and dry, peas have been in some cases attacked by rust, which frequently causes much damage to the crop. There are three forms of fruit in the life-cycle of this fungus, and all are produced in succession on the same plant. First appears the "cluster-cup" (or aecidium) stage, followed by the summer-spore (or uredo-spore) condition, which forms numerous small, brown, powdery patches on the leaves, stipules and stem. This condition reproduces itself throughout the growing period of the host-plant, and is responsible for the spread of the disease. When the plant is fading the summer-spore condition ceases to appear, and is followed, on the same parts of the plant, by a winter-spore (or teleuto-spore) stage. This takes the form of small, nearly circular blackish patches on the leaves and stipules, but the patches are often more or less elongated and streak-like on the stem. Only the spores of the winter form of fungus fruit are capable of infecting plants in the following season, and every care should be exercised in securing their destruction.

This rust, as the scientific name denotes, also attacks broad beans, on which it is much more general and destructive than in the case of peas. It also attacks various vetches and other plants belonging to the pea family.

Methods of Control.—Spraying is practically of no avail against rusts. The most certain means to prevent a recurrence of the disease is to burn infected pea straw; if this is not done the winter-spores will be in some way returned to the land in a condition capable of infecting future crops.

Pea Spot (*Ascochyta pisi*, Lib.).

This fungus attacks the leaves and pods of peas. Pale yellowish spots appear on the pods and gradually increase in size and often encroach on each other. After a time the spots become dry, present a shrunken appearance, and are surrounded by a dark border, and the central sunken portion becomes studded with the minute black fruits (perithecia) of the summer-spore stage of the fungus. When the pods are attacked while young, they often become more or less contorted, and seed is not formed. Infected leaves soon shrivel and die.

It has been stated that a fungus called *Mycosphaerella pinodes*, Stone, is the winter-fruit condition of Pea Spot.

Methods of Control.—Spraying with Bordeaux mixture will hold the parasite in check, if carried out when the earliest symptoms of the presence of the disease are observed.

Black Root Rot, Black Neck, Collar Rot.

This common and destructive disease of Sweet Peas, Asters, Antirrhinums, and many other plants, especially in the seedling stage, is characterised by a blackening of the collar or neck of the attacked plant, followed by a progressive rotting of the tissues, wilting, and rapid death. This has been attributed to attack by the fungus *Thielavia basicola*, Zopf, but is now understood to be due to a *Phytophthora*, perhaps *P. omnivora*, closely related to but quite distinct from that which causes the Irish or Late Blight of Potatoes.

Methods of Control.—As this disease is often due to infected soil in the seed beds these should be sterilised. The beds should be thoroughly soaked with a solution of formalin (40 per cent. formaldehyde) in water in the proportion of one pint of formalin to twelve gallons of water. One gallon of the mixture should be used for each square foot of soil. After the watering is completed the soil should be covered for two or three days with coarse sacking to keep in the fumes. The watering should be done after the seed beds have been prepared for sowing, and a week or ten days should intervene between the watering and the sowing of seed, to allow for the complete escape of the formalin fumes and the drying of the soil.

Streak Disease.

The cause of this prevalent disease is still obscure, but there seems to be little doubt that in England typical streak disease is often caused by unsuitable conditions of growth, and may occur in the absence of either bacterial or fungus pests.

General Methods of Control.

As peas are annuals, an outbreak of disease cannot be due to hibernating mycelium. There is also no evidence to show that the spores of any of the diseases discussed above are conveyed with the seed. Hence it follows that every infection must originate from some outside source. Freedom from disease must, therefore, mainly depend on preventive measures, the most important of which is promptness in destroying (preferably by burning) all diseased material, since this carries the spores, which are the only possible means of starting an infection the following season.

Whitehall Place, London, S.W.,
October, 1915.

Leaflet No. 288.

BOARD OF AGRICULTURE AND FISHERIES.

The Cultivation and Collection of Medicinal Plants in England.

Medicinal herbs have been cultivated in this country for centuries, and in the middle ages were grown in kitchen gardens attached to monastic establishments and great country houses. At the present day materia medica (or drug) farms exist at Mitcham, Carshalton, Hitchin, Long Melford, Market Deeping, and Wisbech, but for many years the main source of British drugs has been Mid-Europe, particularly Germany and Austria-Hungary.

During recent years the acreage devoted to drug cultivation in Britain has been more and more restricted by competition with foreign products, and the result has been a slow but sure ousting of British-grown drugs from the market. The outbreak of a European war has completely changed the situation, and an effort on the part of growers and drug merchants may largely secure for this country in future years the collection and cultivation of medicinal plants which cannot for the present be imported from central Europe.

Supplies of drugs are much in demand, the shortage being serious, and the prices* of most of the crude drugs that were formerly imported from enemy territory have risen very considerably—in the case of Belladonna, for instance, by about 600 per cent.; the prices of other medicinal herbs (Colchicum, Digitalis, Henbane, Stramonium, Valerian, Dill, Dandelion, &c.,) have risen in proportion to the importance and scarcity of the herbs. The present time, therefore, is particularly favourable for the establishment of a home industry in the cultivation of medicinal plants—not only for home use but possibly for export, for it is not anticipated that prices will revert to their old level until long after the war is over. Prices are now sufficiently good to meet with ease the present high cost of labour, and it is felt that judicious cultivation of drug plants should result in quite adequate profits. In connection with labour it is possible that disabled soldiers and sailors could do a great deal of the work required.

In the past year experiments were made in growing Belladonna, Henbane and Blessed Thistle, and the following results have been communicated to the Board :—

Belladonna.—The yield per acre in the first year of growth amounted to about 6 cwt. of dry leaves, which were

* An endeavour has been made to give in this Leaflet average prices in March, 1916, but in view of the considerable fluctuation in prices the Board feel that they can only be taken as a general guide.

sold for 2*s*. per lb., or £67 4*s*. per acre. The price of leaves before the outbreak of war was 60*s*. or under per cwt. (*See also* pp. 5–6.)

Henbane.—The yield amounted to about 15 cwt. of dry herb per acre, the price obtained being about 1*s*. 3*d*. per lb.—*i.e.*, 140*s*. per cwt. or £112 10*s*. per acre. (*See also* p. 10.)

Blessed Thistle.—In the case of this plant the yield amounted to about 35 cwt. of dry herb per acre, the sale price being £29 per ton, or £50 15*s*. per acre. The price before the outbreak of war was £27 per ton. (*See also* p. 11.)

General Considerations.

While the price of the more important drug plants has risen seriously, and British-grown crops are likely to realise high prices, it needs to be fully recognized that the limited outlet for many drugs makes overloading the market a comparatively easy matter, and any grower who proposes to devote attention to the cultivation of medicinal plants should give the matter careful consideration before embarking on it to any serious extent. For growers, however, who can successfully raise good crops, excellent returns should be secured in the near future.

The prospective grower or collector should give close attention to several points which are of importance and may present difficulties :—(1.) How to secure Seed ; (2.) What to Grow or Collect, and Where to Sell ; (3.) How to Dry and Market the Crop.

(1.) *How to secure Seed.*—It will probably be possible to obtain seeds of the various medicinal plants through the larger firms of seed merchants, or through drug merchants and distilling firms interested in buying crops. A list of addresses may be obtained on application to the Board.

(2.) *What to Grow or Collect, and Where to Sell.*—In the ordinary way a few pounds of dried herb are only disposed of with difficulty, buyers requiring hundredweights or none. At present, however, drug plants will be saleable in much smaller quantities than usual. When considering what to grow or collect it is desirable to consult the prospective buyer of the crop, who will usually be prepared to give expert advice on this point, and who of course knows what is likely to be required at any given time. While it is possible to overload the market with a given drug it may be observed that the quantities of crude drugs used are very large. For example, the annual crop of Belladonna in Croatia and Slavonia has been estimated at 60 to 100 tons of dry leaves and 150 to 200 tons of dry root.

If possible the grower should consult wholesale druggists, and preferably make an arrangement with one of these to purchase the crops grown. A useful plan might be to

contract for one half the crop to be taken at a pre-arranged price and the remainder at market prices at the time of harvesting the crop.

It may be said that the plants which are likely to be most in demand, and will be easily saleable during the coming season, are Belladonna, Henbane, Foxglove, Thorn Apple, Valerian, Poppy, Aconite, Blessed Thistle, Dandelion, Chamomile. Many of the other species named below will also find a fairly ready market if well grown or collected, and well marketed.

(3.) *How to Dry and Market the Crop.*—The careful picking or harvesting and drying of medicinal herbs is a matter of great importance, and regular growers have proper drying plant, heated artificially, so that quantities of the drugs can be dried quickly and thoroughly in a current of warm air. Facilities for drying purposes are desirable for growers of medicinal herbs. Glasshouses could readily be converted into drying sheds, especially if heated by pipes. Drying could be done in half shade in fine summer weather by spreading thin layers of the leaves on wooden racks or sheets of paper or cardboard in the open, or on racks or shelves in a freely ventilated shed, turning frequently until quite dry. The leaves or flowers must be kept under cover at night or during rain. "Even colour" is best retained by quick drying, and the brighter the colour the more saleable is the product. Growers or collectors who intend to market dry leaves or flowers could gather and dry in small quantities, which are more manageable. Roots present less difficulty in washing and drying.

In London several establishments make it their business to dry medicinal herbs and roots, and if fresh plants are forwarded by passenger train lightly packed in wooden boxes, in the same manner as flowers are marketed, they would probably usually arrive in good condition, and be carted direct by the buyer to the drying house.

In the forests of Hungary the means of drying are very primitive, consisting simply of a wooden shed divided into compartments of trays made of wire netting tacked on wooden frames. The heat for drying is generated by coke fires, and the ventilation is obtained by making small holes in the walls near the roof.

Growers may find it useful to dry their crop when possible as they will then be less dependent on an immediate market for sale, and be able to arrange better terms of sale, unless they grow by contract, when drying may be a mere matter of convenience as between grower and buyer.

Co-operation.

The most important drug industry—cinchona bark production—has during recent years shown the effectiveness of

co-operation between producer and manufacturer in restricting the output within reasonable limits. So far, consumers appear to be unaffected, while all other handlers of bark and quinine, other than speculators, are in a decidedly better position.

Some arrangement might perhaps be made to ensure British drug growers a fair return for their efforts. Co-operation between growers in any given district, and between growers and wholesale druggists would probably prove effective. It would probably prove a great help in meeting the difficulties of small growers in regard to drying and marketing their produce.

Soil and Manuring.

Soil in good condition for ordinary farm crops is suitable for growing most medicinal plants. In general, care should be taken to keep down weeds and ensure a good tilth. A good dressing of farmyard manure is usually advantageous, although not actually necessary.

The southern and midland counties of England are especially suited to drug growing, and are further favoured in being close to the principal consuming market.

ACONITE (*Aconitum Napellus*, L).

The chief collecting centres for foreign aconite root are the Swiss Alps, Salzburg, North Tyrol and Vorarlberg. Supplies of aconite root from Japan and Spain are also available, so that the demand for English aconite may be restricted, though at present good. The price of the Continental root is about 40*s.* to 50*s.* per cwt., and Japanese (usually ascribed to *A. Fischeri*, Reichb.) about 35*s.* per cwt., while English is ordinarily worth 2*s.* per lb., at which price it still stands. Good crops are grown with some difficulty in England, and cultivation of aconite has not paid well in recent years, even with cultivated root four times the price of wild. Leaves are of little importance.

Cultivation.—The official aconite (*Aconitum Napellus*, L.) grows wild in some shady places in the west of England and in south Wales. It prefers a soil slightly retentive of moisture, and among the drug farms the moist loam of Ampthill and the dark soil at Market Deeping have proved most suited to aconite cultivation.

Beds for growing aconite are all the better for being shaded. The soil should be well dug, and pulverised by early winter frosts. The digging in of rotted leaves or stable manure is advantageous.

Aconite can be raised from seed, but it takes from one to three years to flower. On the drug farm it is usually propagated from the smaller (daughter) roots which develop at the sides of old roots. The underground portions of the plants are dug up in autumn, after the stem has died down,

and sorted over, the plumper roots being reserved for washing and drying to form the aconite root of commerce.

Re-planting is usually done in December or January, the young roots being planted about a foot apart each way. The young shoots appear above ground in February. Although the *plants* are perennial, each distinct *root* lasts only one year, the plant being continued by daughter roots. Aconite would probably grow luxuriantly in a moist open wood, and would yield returns with little further trouble than weeding, digging up and drying. A great disadvantage of growing aconite from seed is the uncertainty as to correctness of the species, an important point as regards medicinal activity.

BELLADONNA (*Atropa Belladonna*, L.).

Prospects.—The bulk of the world's supply of Belladonna was derived from wild plants growing in quantity on waste stony places in Southern Europe, the industry being an important one in Croatia and Slavonia (South Hungary). The largest exporter in Slavonia is stated to have sent out 29,880 lb. of dry Belladonna root in 1908.

Cultivation and Harvesting.—Belladonna grows on most soils but is partial to a chalky substratum. The seeds germinate slowly—in about six weeks; they may be drilled in spring in rows 3 ft. apart, using 2 to 3 lb. of seed to the acre. A reserve of plants is also grown in seed beds to fill in gaps due to dormant seeds and winter's losses. The seed may also be sown in pans under glass, or in frames, early in the year, the seedlings being planted out during May, 5,000 plants being needed per acre. This is perhaps the most satisfactory method, especially in view of the scarcity and high price of seed. Considerable moisture is needed to ensure germination in good time.

The seedlings are liable to injury by late frosts, and a light top dressing of farmyard manure serves to preserve young shoots from injury during sudden and dangerous changes in temperature. Healthy young plants soon become re-established when transplanted, but require watering if the weather is dry at the time of transplanting. Great care must be taken to keep the crop clean in spring, or the seedlings may be choked by weeds.

The plants may be left 18 in. apart the first year, and by September the single stem will be $1\frac{1}{2}$ to $2\frac{1}{2}$ ft. high. A gathering of leaves may then be made if the plants are strong, "leaves" including the broken-off tops of the plant. The coarser stems are left on the plant, and discoloured portions are rejected. Women are employed for gathering. Before the approach of winter plants should be thinned to $2\frac{1}{2}$ to 3 ft. apart. or overcrowding will result in the second

year, in which the plants will bear one or two strong stems.

The English crop is cut with sickles in the second year while flowering in June. and growers must arrange for delivery to the wholesale buyer on the day it is cut.

The average crop of fresh herb in the second and third years is 5 to 6 tons per acre, and 5 tons of fresh leaves (tops) yield 1 ton of dried herb. A second crop is obtained in September in good seasons. The plant is dug or ploughed up during autumn in the fourth year, and the root is collected, washed, and sliced to accelerate drying. In time of great scarcity it would probably pay to dig the root in the third year. Three to four tons of fresh root yield a little over one ton of dry root. The greatest loss of plants is in wet winters. On the lighter soils there is less danger from winter loss, but the plants are more liable to damage from drought in summer on such soils.

The plant grows wild in the Southern Counties of England, especially near old ruins, but it has become much rarer of late years. The fruits ripen from August to October, and those who know the haunts of the plant might profitably gather fruits for sale. The seeds taken from the berries are washed in a sieve and dried.

Prices.—Only a little Belladonna root has hitherto been dug in England, the large supplies used having been derived from the Continent. The Balkan War of 1912-1913 interfered with the continuity of Belladonna exports from Croatia and Slavonia in South Hungary, the chief centres for foreign Belladonna. Stocks of roots and leaves made shorter supplies eke out until 1914, when prices rose owing to increasing scarcity. *Root* which realised 45*s*. per cwt. in January, 1914, sold for 65*s*. in June, 1914, and on the outbreak of war the price immediately rose to 100*s*. per cwt., and at present from 300*s*. to 480*s*. or more per cwt. is paid. Belladonna *leaves* from abroad (*i.e.*, dried) sell at normal times for 45*s*. to 50*s*. per cwt., but at present they are worth from 250*s*. to 350*s*. or more per cwt.

Manuring.—Authorities differ on the question of manuring. English growers manure little if the plants are strong. With soil suited to the plant the effect of artificial manures on growth is often small, but if the soil is really poor the crop may be increased several fold by the use of farmyard manure or a mixture of nitrate of soda, basic slag and kainit.

One authority found that manures tend to lower activity as judged by alkaloidal content. In other experiments artificial manures did not materially alter the proportion of alkaloids in the green leaf, but in several cases the crop was largely increased in weight. Unfortunately, the results were partly vitiated by the death of a large proportion of plants in the third year, for some reason

not definitely ascertained. A French authority states that by using farmyard manure the amount of alkaloids in dried leaves of Belladonna grown at Houdan, France, was doubled, but this only raised the alkaloidal content to the standard of English leaf. From experimental plots an Austrian investigator concluded that manuring increases the yield of the crop by weight. The results of these researches seem to support the custom of Belladonna growers to manure if the soil is poor or the plants are weak.

Seasonal Variation in the Percentage of Alkaloids in the Plant.—There appears to be no marked variation in the amount of alkaloids in Belladonna leaf and stem between June and September, and hence the time of collection is not important, and the leaves may be gathered any time before the leaves and shoots begin to fade.

In the English root seasonal variation in alkaloidal content is said to be very small. Atmospheric conditions appear to have a marked influence, the highest percentage of alkaloid being yielded in plants grown in sunny and dry seasons. The low percentage of 1905 was held to be due to heavy rainfall, and that of 1907 to lack of sunshine.

CHAMOMILE (*Anthemis nobilis*, L.).

Prospects.—The demand for chamomile flowers, though slowly decreasing, is a fairly steady one. Belgium is the chief grower, and on the outbreak of war the price rose from 55*s.* to 80*s.* per cwt. for fair average quality. By the end of August, 1914, 120*s.* was asked for the previous year's Belgian flowers, best quality being 140*s.* per cwt. French-grown chamomile is now sold at 125*s.* to 150*s.* per cwt., but a demand exists for English chamomile, which is normally practically all used for distillation of oil. It will probably pay to grow chamomile, though the labour entailed in collecting English-grown flowers may be more than the price usually obtained for the Belgian drug. Dried English chamomile flowers may be worth about 3*s.* per lb., and the very finest may sell at still higher prices, though possibly not in very large quantities.

Cultivation.—Chamomile prefers a dry sandy loam, but stiffish black loam gives the best crop of flowers. The usual method of propagation is from "sets," each old plant being divided in March into ten or twelve portions, which are planted in rows 2½ ft. apart with a distance of 18 in. between the plants in the row. Chamomile may also be grown from seed, but some of the resulting plants will produce the less desirable single flowers. Weeding is done by hand.

The flowers are picked in September, or earlier if the season is dry. Collecting is done by women and children, payment being made by the pound (normally up to 1½*d.*). Rapid drying is necessary if the flowers are to retain their purity

of colour, the flowers being laid on canvas trays in a heated drying closet. From 5 to 6 lb. of fresh flowers yield 1 lb. of dry flowers; the yield of dry flowers is about 4 cwt. per acre. They are sorted and graded according to colour. A fairly good product would probably be secured if the flowers were picked as they came in bright weather, which is the best time for drying, this being done in the open or in well ventilated sheds in as thin layers as possible.

DANDELION (*Taraxacum officinale*, L.).

Dandelion has been scarce since 1914. Dried English roots have usually been sold in competition with German roots at about 40*s.* per cwt., but 110*s.* was being paid for them in September, 1914, and at present they command 80*s.* to 130*s.* per cwt. In the early part of 1916 fresh root was worth 8*s.* to 10*s.* per cwt. Wherever the dandelion is very plentiful, and grass land is being ploughed up, farmers might collect and dry the roots.

Cultivation.—About 4 lb. of seeds per acre are drilled in rows a foot apart. Hoeing is needed to keep the crop clean. Flower heads are picked off as they appear, before the winged seeds can be dispersed, otherwise the grower's own land and that of his neighbours will be smothered with the weed. The roots are dug the second year in autumn. They may be transported fresh for pressing out the juice or making dandelion extract, or be washed, sliced and dried. The yield should be 4 or 5 tons of fresh roots to the acre in the second year; 100 parts of fresh root yield about 22 parts of dry material.

FOXGLOVE (*Digitalis purpurea*, L.).

The Continental supplies of Digitalis leaves from Thuringia and the Harz mountains are stopped, but there should be enough of the wild plant in England to satisfy home requirements if it can be collected. Dry wild leaves are now worth about 1*s.* to 2*s.* per lb., according to quality, and there is a considerable demand for them.

The Foxglove is cultivated by a few growers in this country for a very limited market, in order to provide a drug of more uniform activity from a true type of *Digitalis purpurea.* Digitalis is cultivated in the partial shade of orchards, but it likes a moderate amount of sun. Its cultivation as a paying proposition to a fruit grower can hardly be recommended. Its culture is that of a garden plant. Digitalis grows best in a well drained loose soil, rich in leaf mould; it is said to dislike chalk, but appears to grow well enough at Croydon and Darenth on calcareous soils. About 2 lb. of seed are required per acre, and as the seeds are so small and light they should be mixed with fine sand in order to ensure even distribution when sown. They should be thinly covered with

soil. The seeds are uncertain in germination, but the seedlings may be readily and safely transplanted in damp weather.

The leaves are hand picked in the second year, from flowering plants, the yield being about 1 to 2 tons of fresh leaves per acre. Great care is necessary in collecting and drying quickly, and a reputation for care is necessary if the crop is to be sold at remunerative prices. Drying is conducted in shade, and the leaves are kept in closed boxes or barrels, as they soon deteriorate if exposed to air and moisture.

DILL (*Peucedanum graveolens*, B. & H.).

English Dill has long had a reputation of its own for distillation of essential oil. It is grown chiefly in East Anglia. There is a considerable shortage due to the stoppage of Continental supplies, the cheap Indian fruit not being an effective substitute. This annual is easily grown and may pay well in years to come.

Cultivation is similar to that of spring oats, 10 lb. of seed being drilled to the acre. Careful attention must be given to the destruction of weeds. The plants require much watching as the time for harvesting approaches. Mowing is begun as the lower "seeds" (fruits) begin to fall, the others ripening on the straw. In dry periods cutting is best done in early morning or late evening. The loose sheaves are built into small stacks of about twenty sheaves tied together. In hot weather thrashing may be done in the field. The crop is considered rather exhaustive of soil fertility. The yield is about 7 cwt. of dill fruits per acre, selling in normal periods at 30*s*. to 40*s*. per cwt., and at present at 45*s*. to 70*s*. per cwt.

FENNEL (*Foeniculum capillaceum*, Gilibert).

The cessation of the supply of the fruits of this species of Fennel from the Continent may tempt farmers to try and grow fennel in this country. Any crop produced is almost certain to sell well. Fennel likes plenty of sun and is adapted to dry and stony situations, but yields best on rich soil on the stiff side. From 4½ to 5 lb. of seed are sown per acre. In the mild climate of France the seed is usually sown in August or September, but spring sowing would be necessary in England. The fruit is heavy and a crop of 15 cwt. per acre would probably be obtained. Cutting should be done before the fruits are fully ripe, as in the case of dill.

Fennel is largely used for cattle condiments. The usual price for German fennel before the war was about 35*s*. per cwt., and an English crop should be grown with good profit at this price. Levant fennel formerly sold at 25*s*. and East Indian at 20*s*. per cwt. Present prices are slightly higher.

HENBANE (*Hyoscyamus niger*, L.).

Prospects.—There are two varieties of henbane—the biennial and the annual. The biennial is cultivated in this country for extract making. There is only a limited demand for this variety, and the established drug farms will probably be able to meet it. Large quantities of the annual variety were imported before the war from Germany and Austria, as well as from Russia, in the form of dry leaves.

The normal price of the dried Continental annual plant is 40*s.* to 45*s.* per cwt. The dried biennial herb is ordinarily worth 3*s.* to 6*s.* per lb., and at the present time 8*s.* or 9*s.* per lb., the best selected herb being worth 10*s.* per lb. The annual herb is worth 120*s.* to 180*s.* per cwt.

Cultivation.—Henbane grows in similar situations to Belladonna, and its cultivation is much the same, except that the seed must be sown in the open, as the seedlings will not stand transplanting, but must be thinned out in the rows. The seeds, however, are prone to lie dormant, and the crop is a little uncertain, sometimes dying in patches. Commercial henbane seed is often kiln-dried and useless for sowing. The annual variety is smaller and does not branch so freely as the biennial plant, so that it may be sown in rows 18 in. apart, and the biennial 2 to 2½ ft. The leaves (flowering tops) are gathered when the plants are in flower (biennial June or July, annual August). The root is not used in medicine. The fresh herb loses 80 to 86 per cent. of its weight on drying, 100 lb. yielding 14 to 20 lb. of dry herb.

"EGYPTIAN HENBANE" (*Datura Metel*, L.).

This plant is a valuable source of the medicinal alkaloids hyoscine, hyoscyamine and atropine. It has been grown in this country in the same way as Thorn Apple (p. 11).

OPIUM POPPY (*Papaver somniferum*, L.).

Prospects.—The white variety of the opium poppy is still grown in several parts of the country, notably Lincolnshire, for the sake of its capsular fruits. The crop is always a precarious one, but there is a steady market for poppy heads. Belgium has usually supplied a proportion of the poppy heads used in this country, but not sufficient for the loss of her crop to cause serious shortage on the British market. The price paid for poppy heads is normally 12*s.* to 15*s.* per 1,000 for large size, and 8*s.* to 10*s.* for medium. Present prices are about the same, or rather higher.

Cultivation.—Poppies prefer rich, moist soil with plenty of sun, and the usual practice is to take a crop after wheat, oats

or barley. The land is manured and ploughed in autumn to ensure a fine tilth in spring. Sowing is done at the end of March or in April according to weather, allowing 1 lb. of seed per acre and drilling in rows a foot apart. The whitest seeds are preferred. Plants which are too forward are liable to be cut down by late frosts, while, if seed is sown too late, the seedlings may become dwarfed if dry weather sets in before they become well established. A light roller is sufficient to ensure the seeds being covered.

When the plants are 3 or 4 in. high they are cut with a hoe into clumps about 6 to 9 in. apart, and are afterwards "singled" by women or children, leaving a solitary strong plant from each group. Weeding is necessary. A dressing of soot may be given if support appears to be needed.

Poppy heads of pale colour are most desired, but a week's rain or even a few nights' heavy dew may spoil the colour of the ripening fruits. High winds and heavy rains are dreaded, as the plants become top-heavy. The capsules are harvested by women or children about September; they are broken off and placed in baskets, and are transferred to sacks to be conveyed to the drying floor. The yield is very variable. The drying floor is a boarded floor in a freely ventilated warehouse, and on it a thin layer of capsules is turned each day by shuffling the feet along the floor. The capsules usually take a fortnight to dry.

BLESSED THISTLE (*Cnicus benedictus*, L.).

This plant occurs in waste, stony, uncultivated parts of southern Europe, and is an annual. It is cultivated for medicinal purposes, the leaves and leafy flowering tops being collected just about the time the plant breaks into flower. Drying should be done quickly and thoroughly, the fresh green of the foliage changing during the process to a gray-green. At the present time the dried herb is worth 38*s.* or more per cwt. About 3½ tons of the fresh herb produce 1 ton when dried.

THORN APPLE (*Datura Stramonium*, L.).

Prospects.—The Thorn Apple is not grown on a commercial scale in this country. The principal use of the drug is as an ingredient in burning powders for asthma, considerable amounts of the wild leaves having been imported from Hungary. The normal price of foreign Stramonium leaves is about 40*s.* per cwt., but 80*s.* was asked soon after the outbreak of war; the present market price is about 50*s.* to 70*s.* or more per cwt. The seed is also a commercial article, but demand is very limited. The plant is an annual and easily grown. The dry leaves would find a ready market.

Cultivation.—The seeds (10 lb. to 15 lb. per acre) are drilled in rows two feet apart. The plants grow well in sunny situations. The crop is cut with the sickle when in flower in late summer. The leaves are stripped off and dried as quickly as possible in shade, usually by gentle artificial heat. About 34 parts of dry leaves are produced from 100 parts of fresh leaves. The thorny capsules are gathered from plants allowed to stand, when full grown but still slightly green. They split and shed their seed on drying.

VALERIAN, ALL-HEAL (*Valeriana officinalis*, L.).

Prospects.—Valerian is common in England in moist situations. Most of the drug plant of commerce consists of rhizomes ("root") from plants grown in Derbyshire, or imported from Holland, Germany and France. The foreign root was selling in January, 1914, at 30*s.* per cwt., English being worth about four times that price, 1*s.* to 1*s.* 3*d.* per lb., and prices are about the same at the present time. Very little valerian is now cultivated in this country.

Cultivation.—In Derbyshire cultivation is from wild plants collected in local woods and transplanted to the prepared land. Preference is given in collecting to daughter plants and young flowering plants which develop at the end of slender runners given off by the perennial rhizomes of the parent plant. Many of the young plants do not flower in the first year, but produce a luxuriant crop of leaves and yield rhizome of good quality in the autumn. Planting is usually done on land treated with farmyard manure. Weeding requires considerable attention, and it is advantageous to give plenty of liquid manure from time to time. The plants require plenty of water. Any flowering tops are cut off, as they appear, to encourage the growth of the rhizome as much as possible. In September or October the tops are cut off with a scythe and the rhizomes dry up and are harvested. The clinging character of the Derbyshire soil does not allow them to be left later.

The rhizomes are sliced longitudinally to facilitate washing, which is done in a large perforated wooden box 2 to 2½ ft. deep, secured by stakes in the bed of a local stream, a rake being used to stir up the "hearts." The rhizomes are dried on a shed floor about 6 ft. from the ground. The wet material is strewn on perforated boards, below which a large coke stove is kept going until the drying is complete. About 1 cwt. of the dry product is obtained from 4 cwt. of fresh rhizome. Derbyshire valerian plants are of two varieties, *V. Mikani*, Wats., on limestone, and *V. sambucifolia*, Mikan, on the coal measures. The former yields most of the cultivated Derbyshire rhizome.

Male Fern (*Aspidium Filix-Mas*, Sw.).

The Male Fern is one of our commonest indigenous ferns, growing luxuriantly in moist, sheltered situations. Germany (Harz and Thuringia) formerly supplied all the male fern rhizome or extract used in this country, and any rhizome collected in this country will meet with a ready sale. The supply is not meeting the demand.

Meadow Saffron (*Colchicum autumnale*, L.)

This handsome but highly poisonous plant is abundant in moist meadows in some parts of England and will be much wanted. The corms (or underground "bulbs") should be dug up in July after the leaves have faded, but they are found with difficulty and are hence usually collected later when in flower in August and September. The plant occurs in grass land, but in view of the fact that it is poisonous to farm stock,* should be destroyed, and it would pay to collect it. Fresh corms are at present worth 15*s.* per cwt., and the seeds, which are very scarce, 170*s.* to 200*s.* per cwt.

Other Medicinal Plants.

Experimental growing of some American drugs such as senega, grindelia, pokeroot, golden seal, and lobelia, has been made in England, but without much success.

"Botanical herbs" for sale by chemists and medical herbalists are cultivated at Carshalton. They are grown in rows, which are increased in number according to the demand. The following are regularly cultivated, and some of them may be collected in the wild state :—

Balm (*Melissa officinalis*, L.), for herb.
Comfrey (*Symphytum officinale*, L.), for root.
Feverfew (*Chrysanthemum Parthenium*, L.), for herb.
Greater Celandine (*Chelidonium majus*, L.), for herb.
Wood Sage (*Teucrium Scorodonia*, L.), for herb.
Marshmallow (*Althæa officinalis*, L.), for root and leaves.
Mugwort (*Artemisia vulgaris*, L.), for root.
Pennyroyal (*Mentha Pulegium*, L.), for herb.
Rue (*Ruta graveolens*, L.), for herb.
Southernwood (*Artemisia abrotaneum*), for herb.
Tansy (*Tanacetum vulgare*, L.), for herb.
Wormwood (*Artemisia Absinthium*, L.), for herb.
Yarrow (*Achillea Millefolium*, L.), for herb.

These herbs and roots are in steady demand, and although those grown in England are preferred Continental supplies

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* *See* Leaflet No. 222 (*Meadow Saffron*).

have had to be imported in the past to satisfy all needs. They are easily grown from seed, but propagation is commonly by division of old perennial plants. They succeed well from cuttings. Only pennyroyal presents uncertainty as regards crop, this species being diminished by drought. Most of these crops are normally worth in the dry state from 20*s.* to 30*s.* per cwt., but prices at present range from 40*s.* to 60*s.* per cwt.

Herbs which may be Collected.

Owing to short supply there is a fair demand for buckbean leaves, centaury, coltsfoot leaves, feverfew, figwort, marshmallow leaves and root, meadowsweet, wild carrot fruits, and yarrow. These include some of the commonest British wild plants, but in the ordinary way few are collected in England except by herbalists, or by herb gatherers on behalf of a few agents for wholesale firms.

The herb collector's calling is a poor one at the best of times, but there is now every prospect of a rich harvest for some time to come. His outfit consists of some old sacks and a "paddle"—a strong iron spud 10 in. long with a cross foot-piece and tough 4-ft. ash handle. With this a hard day's work may result in a hundredweight of dandelion roots being taken to a middleman for forwarding to the manufacturer. The medicinal plants dealt with below are now in greater request than usual, besides wild aconite, Belladonna, henbane, and Stramonium. Farmers and landed proprietors might be asked to allow access to their estates for the purpose of judicious and careful collecting by trustworthy herb-gatherers or local botanists, who, however, should undertake to leave sufficient of all plants to continue the species without unduly reducing it.

Barberry (*Berberis vulgaris*, L.): bark is wanted. Ordinarily it is worth 40*s.* per cwt. in the dry state, but at present the root bark is worth about 80*s.* per cwt. and the stem bark 40*s.* per cwt. Home supplies are insufficient.

Bittersweet (*Solanum Dulcamara*, L.) grows wild in moist, shady situations, and is common in hedges and thickets throughout England. There is only a small demand for the drug, which is prepared from the smooth, two or three-year-old (about ¼ in. thick) branches collected in autumn after the fall of the leaves. The branches should be dried and cut into pieces about ½ in. long with a chaff cutter.

Broom (*Cytisus Scoparius*, Link.): the brush-like branches contain most alkaloid in winter, but are also gathered in June for expression of juice.

Buckbean (*Menyanthes trifoliata*, L.): leaves are generally collected in spring. The plant is a marsh herb distributed throughout Britain.

Burdock (*Arctium Lappa*, L.): the root is still used.

Centaury (*Erythræa Centaurium*, Pers.) is common in this country, and the dry herb is required.

Coltsfoot (*Tussilago Farfara*, L.): the leaves retain some reputation as a household remedy. Plenty are to be had for the trouble of collecting, the plant abounding on poor, stiff soils. The leaves are collected in June or July. The flowers which appear in spring are also used to a slight extent, as well as the root.

Couch Grass (*Agropyron repens*, Beauv.): the washed and dried rootstock, chopped up in a chaff cutter for convenience, is in considerable demand, and is worth £40 to £60 per ton.

Elder (*Sambucus nigra*, L.): flowers are needed more than usual. They are plentiful, but require quick collection and rapid transit if they are to be used fresh for making elder flower water. They can be preserved for future distillation by mixing them with 10 per cent. of common salt.

Figwort (*Scrophularia nodosa*, L.) occurs in moist situations throughout England.

Hemlock (*Conium maculatum*, L.) is a biennial growing wild on the banks of streams, along edges of fields or in neglected meadows. It is used chiefly for the expression of conium juice. It is collected in June from second year plants.

Horehound (*Marrubium vulgare*, L.) grows wild in this country, but is not common. It might pay to cultivate as it is in steady demand.

Meadowsweet (*Spiræa Ulmaria*, L.): more than usual of this herb will need to be gathered.

Mullein (*Verbascum Thapsus*, L.): this biennial plant occurs fairly frequently on roadsides and waste places in Britain. There is a fair inquiry for dry leaves and flowers.

Red Poppy (*Papaver Rhoeas*, L.): the petals find a steady if limited market. Farmers can arrange to deliver fresh petals to manufacturers. Children can gather the petals, placing them in a linen bag suspended round the neck, leaving both hands for work, and with a little teaching might be a positive help in preventing the spread of this cornfield weed.

Rose petals will be much in demand, Continental supplies being cut off. They usually realise 3*s.* to 4*s.* per lb. when dry, but are at present much more valuable. Any dark red rose petals are suitable, and some organisation for collection and drying could be arranged in rose-propagating centres.

Sweet Flag (*Acorus Calamus*, L.) can be found in quantity along the edges of streams and lakes. The dried rhizome will be readily saleable.

Yarrow (*Achillea Millefolium*, L.) is one of the commonest British plants, and the dry flowering tops are utilised.

Whitehall Place, London, S.W.,
October, 1914.
Revised, June, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 289.

BOARD OF AGRICULTURE AND FISHERIES.

A Disease of Wheat.

(*Cladosporium graminum*, Corda.)

It occasionally happens, especially after exceptionally wet harvest weather, that wheat gathered in apparently first rate condition and perfectly good for milling purposes has, when tested for seed purposes, a low germinating capacity, not higher, perhaps, than forty or fifty per cent. Except that the space occupied by the embryo is a little depressed or shrunken, the grain may, to all outward appearance, be good, bright, plump and dry. For this reason suspicion seldom falls on the seed when the crop is a failure in the following season, such failure being generally but incorrectly attributed to some wholly different cause. Further, it is not usually possible to determine in the winter or spring, from an examination of such plants as grow from diseased seed, what is the cause, though suspicion may be roused when it is found that the seed is slow in germinating and that many of the plants die subsequently.

Affected wheat may, however, be detected when in flower, or at any time before it is threshed, by the presence of a minute fungus on the chaff (which is discoloured with a blackish or olive green stain), or occasionally on the leaves, leaf-sheaths and even the ears if the attack is severe. As a rule but little injury results from the presence of the fungus on the leaves, but when the ear is attacked considerable loss may result. The severity of the attack is probably much influenced by the weather conditions.

Life History of the Fungus.

The fungus, which belongs to a group of fungi the final (or ascigerous) stage of which is unknown, passes through two stages, (1) the *Hormodendron* or active stage, in which it used to be known as *Scolecotrichum graminum*, Fuckel, and (2) the *Cladosporium* or resting stage which gives it the name now usually adopted. In the former stage the fungus produces chains of very minute spores known as secondary conidia, which infect the host plant. So long as the fungus is living as an active parasite the *Hormodendron* form of fruit alone is produced and is responsible for the rapid spread of the disease. Mycelium is also formed which invades the host plant in every direction, apparently possessing the power of dissolving the cell wall to a certain extent, since it may be found, by the aid of a microscope, inside the cavity of the bristle-like hairs which form the "beard," and to be much wider than the original cavity along which it has

grown. When, however, the vitality of the host plant begins to wane the second or *Cladosporium* stage is produced, and numerous spores and micro-sclerotia are formed which act as resting spores. These serve to tide the fungus over the period when no living host plants are present, and furnish the secondary or *Hormodendron* conidia referred to above.

Distribution of the Disease.

The disease is not always present in a virulent form. In its mildest form it is probably very widely spread, and is present every season in every country where wheat is sown. It generally escapes observation and there is no means of estimating its distribution, even in England. The reason for this is that the fungus does not as a rule extend beyond the glume or chaff on which it usually lives. In more severe cases the mycelium enters into the pericarp or outer covering of the grain, but only to a limited extent, so that the seed germinates and grows vigorously for a time. If, however, the fungus has an opportunity to grow it will penetrate still further into the embryo and destroy the plant. In extreme cases the fungus mycelium is found to have penetrated the ear, and then the seed will not germinate at all.

The fungus is known to attack many wild grasses, and to this is due the specific name.

Methods of Control.

Nothing can be done to check the progress of the disease while the plant is growing. The only precaution that can be taken is to have the seed tested, especially after a wet harvest, and to reject all samples that do not show a reasonably high percentage of germination.

Whitehall Place, London, S.W.,
July, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. ***Letters of application so addressed need not be stamped.***

Leaflet No. 290.

BOARD OF AGRICULTURE AND FISHERIES.

The Cattle Testing Station of the Board of Agriculture and Fisheries.

Need for the Efficient Testing and Treatment of Animals.

The regulations of many colonies and foreign countries relating to the importation of live stock prescribe the examination of all imported animals with a view to the certification of the absence of certain diseases. The examination must be carried out in the country of origin, or in the country of destination, or in both countries. This fact points to the need for the thorough and reliable examination, before shipment, of all valuable animals to be exported from this country. Without such examination the stock are liable to become a total loss through rejection and slaughter in the importing country. If, therefore, reliable testing for Tuberculosis could be guaranteed, trade should be much facilitated and increased, while great expense would be saved by the removal of the element of uncertainty and the consequent lowering of the rates of insurance.

Another cause which acts as a deterrent to the export trade in valuable animals, especially where the trade is with tropical or sub-tropical countries, is that foreign breeders are loath to import susceptible pedigree animals when they are likely to come in contact with natural infection in the importing country itself. It is well known that considerable losses have occurred in this direction, and the question arises as to whether it is possible to render animals going to tropical and sub-tropical countries resistant to the diseases prevalent in those countries.

The Board's Cattle Testing Station.

The various considerations discussed above have led to the foundation by the Board of an Official Cattle Testing Station. This Station is situated at Pirbright, Surrey, and has accommodation for 100 head of cattle. The work carried out at the Station is, at present, confined to the testing of cattle for Tuberculosis, and to the immunisation of cattle against Red

Water. It is hoped, however, to provide further facilities if necessity arises, both as regards accommodation and as to the tests and immunisation.

It may be explained that the virus of tropical Red Water has been effectively maintained at the Board's Veterinary Laboratory for nearly nine years, and the strain has been reduced in virulence to the extent that it will not cause fatalities among the animals inoculated with it. When animals receive this virus they suffer from a more or less mild attack of the disease and recover without being seriously impaired in health. After recovery they are highly resistant to a second attack of the disease, whether an attempt is made to infect them by inoculation or whether they are exposed to natural infection. The time required for an animal to undergo the immunising process and be fit for shipment is from three weeks to a month. It is admitted by veterinarians and importers that animals which have been immunised before leaving England are highly resistant to Red Water when put to graze on infected areas. Through the instrumentality of the Chief Veterinary Officer of the Board no fewer than 328 animals have been immunised in the last few years and shipped to South Africa, Rhodesia, East Africa, Brazil and Argentina, and reports on these animals after landing in infected countries have been highly satisfactory.

Another disease, Anaplasmosis, occurs in the same districts as Red Water, and was formerly confused with it. If an animal contracts the two diseases together the results are often fatal. There is a certain amount of evidence, however, to show that animals which have previously been immunised against Red Water have a better chance of recovering from Anaplasmosis than animals not so immunised.

Fees.

A fee of £6 per head is charged for the tuberculin test, a fee of £5 per head for immunisation against Red Water, and a fee of £10 for the tuberculin test and immunisation combined. The fact that an animal has passed the tuberculin test or has been successfully immunised against Red Water will be certified under the seal of the Board. The fees include all charges for testing or immunisation, for food and attendance during the time required to carry out the operations, and for conveyance between the Testing Station and Brookwood Railway Station (L. & S.W. Rly.).

Payment of fees is to be made prior to the despatch of an animal to the Testing Station, by cheque, or by postal or money order, payable to the order of the Board of Agriculture and Fisheries and crossed "Bank of England," and is to be forwarded to *The Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.* A form to accompany the remittance will be furnished by the Board, when notifying an owner that an animal can be received at the Station. The Board do not undertake to accept delivery of an animal until the fee for it has been received.

FIG. 1.—View of the Front with Water Towers.

FIG. 2.—Isolation Boxes.

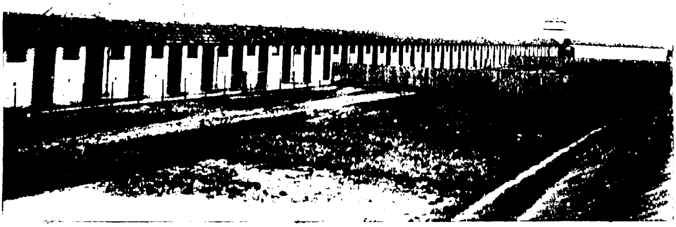

FIG. 3.—A Range of Fifty Boxes in the Exercise Court Yard.

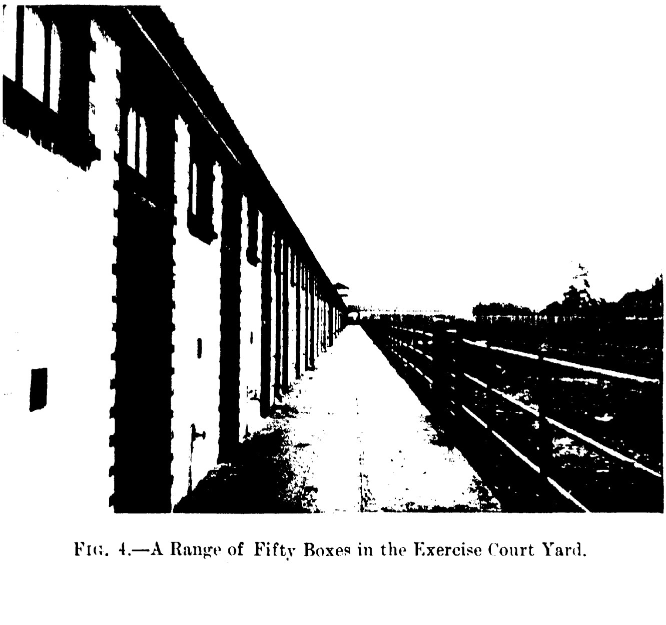

FIG. 4.—A Range of Fifty Boxes in the Exercise Court Yard.

Conditions to be observed by Owners, &c.

Owners are responsible for the carriage of animals by rail to Brookwood Railway Station and thence after testing or immunisation to ports of embarkation.

Animals will be kept under observation at the Testing Station prior to the tuberculin test for 28 days, and an animal will be tested and available for removal after 31 days from the time of its arrival at the Station, unless the test has to be postponed owing to some unforeseen circumstance. An animal received for immunisation only, will, in the ordinary course, be available for removal after 28 days. Where both operations are to be carried out the animal will have to be at the Testing Station for about 56 days. Animals should not be sent to the Station for longer periods prior to shipment than will suffice for their being tested or immunised as the case may be.

If an animal is kept for a longer period than is necessary at the Testing Station to suit the convenience of an owner, an additional charge at the rate of 30s. per week will be payable by the owner on demand by the Board, but if the excess period is owing to any unforeseen and unavoidable circumstances, this charge may be reduced by the Board.

Animals with respect to which certificates of immunisation have been issued are to be moved from Brookwood Station by rail, in sealed vans if required by the Board, direct to the port from which they are to be exported.

Applications for the testing or immunisation of cattle should be made at least a month before the date on which it is proposed to send the cattle to the Cattle Testing Station. Forms of application can be obtained from *The Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.*

An undertaking is to be given that an animal which has been immunised will not be removed from the Testing Station except direct to the vessel on which it is to be exported.

The Board reserve power to refuse acceptance of an animal or at any time to return to the owner an animal if its retention in the Testing Station is, in the opinion of the Board, undesirable from any cause.

Every animal sent to the Testing Station must be provided with a strong head-stall or halter, and notification is to be given in respect of any animal that has at any time proved to be vicious or dangerous.

Where more than one animal is consigned to the Testing Station by an owner each animal is to be marked for the purpose of identification by affixing an ear-tag or otherwise.

The animals whilst under the charge of the Board will be under the care and supervision of their Veterinary Officers, but the Board will not be liable, nor will compensation be paid, for any loss occasioned by the death, slaughter, injury, or illness of an animal, or by an accident to an animal, whilst under their charge or subsequently.

The Board reserve power, where they consider it to be necessary or desirable, to slaughter injured animals and dispose of their carcasses. The proceeds will be paid to the owner.

Should an animal react to the tuberculin test, it will be disposed of in accordance with the directions (if any) given by the owner on the application form. If no such directions have been given, the animal will be consigned at owner's risk and cost to the premises from which it was sent to the Testing Station.

For the purpose of identification every animal in respect of which a Certificate is issued will be marked on the hoof or otherwise with a number by which the animal will be described on the Certificate.

All communications should be addressed to *The Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.*, except notifications as to the time of arrival of animals. The latter should be sent direct to *The Inspector in charge, The Cattle Testing Station, Pirbright, Surrey.*

Note.—The Government of the United States of America employs its own agent in this country to test cattle before exportation.

(The Board are indebted to the Sport and General Press Agency for the use of the photographs illustrating this Leaflet.)

Whitehall Place, London, S.W.,
January, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 291.

BOARD OF AGRICULTURE AND FISHERIES.

The Food Value of Acorns, Horse Chestnuts and Beech Mast.

Acorns, horse chestnuts and beech mast may all be used as food for stock if fed with discrimination, though there is evidence to show that if carelessly fed the results in the case of acorns and beech mast may be serious. Relatively, however, serious accidents are so few that there is no reason for avoiding these foods in times of scarcity, and the Board feel that at the present time full use might be made of them, subject to their being unaltered by moulds or ferments, and to their being given only in small quantities in conjunction with other food stuffs.

Owners and occupiers of land who do not themselves have these products collected would probably gladly allow cottagers and others to gather them for their own use.

Acorns.

It is an old-established custom in Great Britain to collect acorns for pig-feeding, or to turn out cattle and pigs to gather up the fallen fruits. Centuries ago, when fewer varieties of crops were grown, the rural population found the yearly yield of acorns of great value for feeding their pigs. In some parts of the country it is still the custom to collect acorns for the pigs, for feeding which they are commonly valued at about 1*s*. per bushel, though their real food value is probably much higher.

During the last thirty or forty years, however, there has apparently been a growing reluctance to utilise acorns to the extent which formerly prevailed, and this may be in part due to the fact that large numbers of cattle under three years old have been lost owing to the so-called "acorn poisoning."

There is some risk of injurious effects from the consumption of large quantities of acorns by young cattle, though not apparently by cattle over three years old, sheep and pigs. The "poisoning" does not usually follow on the consumption of acorns in small quantities, but is commonly due to full meals of acorns without adequate supplies of water in periods when there is a dearth of herbage. The evidence shows that when acorns, in sound condition, are given judiciously, in small quantities only, they are unlikely to cause any ill-effects, but are a valuable addition to the ration, more particularly in the case of pigs, but also for sheep and adult cattle.

The food value of acorns lies chiefly in the large quantities of digestible carbohydrates which they contain. On this account they would form a useful supplementary food to green fodder, and to such foods as are rich in protein, and they could, to a certain extent, replace in the ration cereal and other foods rich in carbohydrates.

Fresh acorns should preferably be fed only to pigs, sheep, goats and adult cattle, in moderate quantities, along with other foods, and the change to the ration containing acorns should be effected gradually. It is not safe to feed fresh acorns in any considerable quantity to pregnant sows, dairy cows or young cattle. Where pigs are driven into woods they must be given green or other complementary food which will supply a sufficiency of phosphates and lime, necessary substances which are present in acorns in only small quantities. Special care must be taken to withhold cattle from pastures where unripe acorns have been blown down.

Drying the acorns improves the flavour and feeding value and reduces the risk of illness, and acorn meal, prepared by grinding the kernels after drying and then separating them from the cracked husk by sifting after roughly crushing, has a feeding value approximately equal to that of barley meal and oat meal. Care should be taken not to feed any mouldy acorns.

NOTE.—The following are the symptoms of "acorn poisoning," which, as has been explained, affects young cattle almost exclusively :—Progressive wasting, entire loss of appetite, diarrhœa (which may sometimes be tinged with blood), discharge of an excessive quantity of pale urine, sore places inside the mouth, discharge from the nostrils, and also from the eyes, which are always sunken, giving the animal a peculiar haggard expression. No fever is present from first to last, but, on the contrary, the temperature is commonly below the normal standard, though in some cases stated to be above the normal. (*See also* Leaflet No. 13, *Acorn Poisoning.*)

Horse Chestnuts.

The quantity of horse chestnuts that may be fed to animals need not be limited from considerations as to any poisonous effects, as they do not appear to be poisonous.

The following quantities of fresh and unprepared nuts have been fed per head per day :—½ lb. to 1 lb. to sheep, or up to 2 lb. to fattening sheep ; 4 to 10 lb. to dairy cattle ; about 12 lb. to working oxen ; and about 6 lb. to horses. They may be fed whole, but should preferably be crushed ; they should on no account be fed unprepared if they are mouldy. It is doubtful whether pigs can be induced to eat them unprepared, but in the form of meal pigs have been given up to 1¼ lb. with good results.

Wherever practicable, and especially where it is intended to feed quantities of chestnuts to stock, chestnut meal should

be prepared from the kernels after removing the husk. The nuts can be dried in a hop oast by using a good fire, or in any oven in which the temperature can be raised to about 160° F. After drying and partial crushing the greater portion of the outer husks may readily be removed and the residue ground to a meal of any desired fineness. Auld remarks that to obtain a meal of better flavour, to which animals can be sooner accustomed, the nuts, after drying and partial crushing, may be allowed to soak in cold water over-night, after which they are boiled for half-an-hour or so; the water is then rejected, and the residue is dried, partially husked, and reduced to a meal as before. Horse chestnut meal prepared in some such a way would be a fairly concentrated food, and would prove very useful for fattening purposes or for store cattle once the animals can be accustomed to the food. Based on a comparison of starch equivalent 1 lb. of horse chestnut meal would be equal to 1 lb. 1 oz. of feeding barley, or 1 lb. 4 oz. of oats, or 1 lb. 8 oz. of bran, or 2 lb. 5 oz. of good meadow hay.

Both the whole chestnuts and the meal are chiefly valuable on account of their content of digestible carbohydrates. They would form a suitable supplementary food to watery foods, *e.g.*, green fodder, silage, root leaves, or beet pulp, and they would also be useful when feeding damp food or green food wet with rain. On the other hand, chestnuts are somewhat astringent, and if taken in large quantities unaccompanied by watery foods have been known to cause digestive disturbances, particularly stoppage. The addition of salt not only prevents this, but has the effect of making the ration more tasty. Oil cakes rich in protein, hay, and straw seem suitable complementary foods in addition to the watery foods mentioned above. Owing to their high total digestibility, chestnuts would probably increase the total digestibility of a ration in which they are fed as a supplementary food. Where animals cannot at first be induced to eat the nuts or meal, a little treacle may be added to mask the bitter taste.

Beech Mast.

Comparatively little seems to be known as to the value of beech mast as a feeding stuff, and no exact experiments appear to have been carried out with it. It may be said, however, that beech mast should not be fed to horses, which are susceptible to a deleterious constituent of the mast, and that sheep will either not eat the mast at all, or can only be made to do so under compulsion. Further, the husk contains so high a percentage of crude fibre that the whole mast is unsuitable for feeding purposes, and only the kernel should be fed. A fine oil is obtained from the

kernel, and hence the question of feeding the residues (or cake) might arise.

The shelled kernels and shelled cake are rich in albuminoids but have a low content of carbohydrates, so that suitable complementary foods would be those poor in protein but rich in carbohydrates. The small quantities of tannin present are negligible from the feeder's point of view.

Beech mast has been fed to cattle and pigs without harm, and it is stated that cattle are not susceptible to the constituent which has been found harmful to horses. Poultry, especially turkeys, readily eat beech mast, on which they fatten quickly.

Beech mast which has become damp or slightly mouldy should be cooked before feeding. Plenty of drinking water should be allowed to the animals.

NOTE.—A full account of the food value of Acorns, Horse Chestnuts and Beech Mast was given in the *Journal of the Board of Agriculture*, September, 1914 (price 4*d.*, post free).

Whitehall Place, London, S.W.,
October, 1914.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 292.

BOARD OF AGRICULTURE AND FISHERIES.

Foot-and-Mouth Disease.

Foot-and-mouth disease is caused by a virus which is too small to be seen by the aid even of the highest powers of the microscope, and it can pass through the minute pores of bacterial filters. Such a virus is spoken of as "filterable." Its nature is not yet definitely known, but in view of the character of the disease caused by it, the virus is probably bacterial.

Animals Subject to the Disease.

Practically all the domestic animals and wild ruminants can be infected with foot-and-mouth disease. This statement, however, requires a certain amount of qualification. Cattle are usually looked upon as more susceptible to the disease than sheep, pigs, and goats, but the experience in Great Britain during the last few years has been that, given an outbreak amongst pigs or sheep, the disease spreads as rapidly as in the case of cattle. Human beings may also contract foot-and-mouth disease, though they are not in the most susceptible class. Horses, dogs, and cats have occasionally been known to contract the disease under natural conditions, but owing to the resistance they show to experimental inoculation with the virus, and the infrequency of naturally contracted attacks of the disease amongst them, they must be considered much less susceptible than cattle, pigs, or sheep.

The degree of susceptibility varies considerably, even amongst susceptible animals, and it has not infrequently been observed that certain animals appeared to resist infection when their fellows were suffering from the disease.

Symptoms.

As the owner and attendants are often the only persons in a position to suspect the existence of disease in the first instance, the symptoms are described here to enable them to be on their guard against it, but not with the object of encouraging them to attempt to distinguish between foot-and-mouth disease and other diseases with somewhat similar symptoms. Foot-and-mouth disease is so serious to stockowners in general, that, if there is the least suspicion of its presence, that suspicion should be reported immediately to the authorities. (See last section of this leaflet on *Reporting the Existence of the Disease.*)

The incubation period after natural infection is from 48–72 hours to ten days, but the shorter periods are the more usual.

The chief symptoms of the disease are common to all affected animals, although the effects of the virus vary somewhat. In the initial stage the animals are dull, off their food, and if the temperature is taken, it will be found to be higher than normal—105° F. or even higher in cattle. At this stage, however, it is unlikely that a farmer would suspect the existence of foot-and-mouth disease.

The first symptoms of the disease to attract the farmer's attention are the sudden appearance of lameness, or slavering at the mouth, or both. Lameness in a number of animals, especially if present in more than one species—cattle and pigs or sheep, for example—should arouse the gravest suspicion. Salivation (slavering) in a number of animals or even in one animal should always be looked upon with suspicion, and should lead to an examination of the mouth. In affected cattle salivation is very frequently accompanied by a smacking or sucking sound, which is a very characteristic symptom of the disease. Slavering, however, is not nearly so noticeable in pigs and sheep as in cattle, and it is usually sudden lameness which first attracts attention in the first two. It is to be noted, also, that the lameness might escape the casual observer, as the animals are often so footsore that they remain lying down. Cattle, however, when moving, frequently shake their feet, as if trying to remove something from a hoof. Sheep, of course, will usually rise and move away when approached; if not, it probably means that their feet are very tender.

The lesions of the disease consist of vesicles (blisters) which appear on the mucous membrane, especially that of the mouth, and on the finer parts of the skin. In the mouth they appear on the pad, on the inside of the lips, and on the tongue. About the feet they are usually found around the coronet, at the junction of the skin with the hoof, at the base of the supernumerary digits, and on the soft tissue between the clays. They are also commonly found on the teats in females. Less commonly they may be seen around the muzzle, inside the vagina, and in pigs on the skin of the body. The vesicles vary in size and shape; quite commonly they are an inch in length, but they may be much smaller. They are easily broken by handling. When broken a clear liquid flows out, the mucous membrane over the vesicle looks ragged, and the under surface has a very red or raw appearance, which afterwards becomes yellow. On parts like the pad, where the mucous membrane is dense, the affected part of the mucous membrane may be much thickened, and may remain attached after the vesicle is broken. On handling, this thickened portion of membrane comes away in the form of leathery-looking tissue

FIG. 1.—Feet of a pig affected with foot-and-mouth disease. The vesicles have ruptured and the horn is separating.

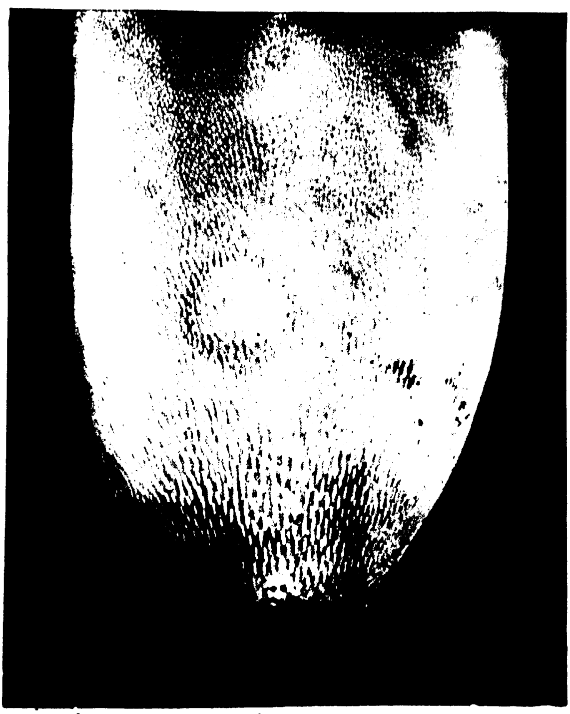

FIG. 2.—Portion of the tongue of an ox, showing early lesions of foot-and-mouth disease. The tip of the tongue shows a recently ruptured vesicle, while further back an unruptured vesicle is seen.

Fig. 3.—Tongue of an ox affected with foot-and-mouth disease, showing two recently ruptured vesicles and a considerable amount of scaling of the epithelial covering at other parts.

leaving a raw surface. About the feet the vesicles are similar to those in the mouth, except that the covering is denser. Cattle at pasture often show rapid loss of condition when attacked, as, owing to the pain in their mouths and feet, they are unable to obtain sufficient nourishment. In milch cows the milk yield falls considerably, and when the teats are affected, injury of a permanent nature may arise in the udder. The inflammation in the feet may lead to shedding of the horny parts. This happens in the later stages of the disease, but more commonly in sheep and pigs than in cattle. Even in the earlier stages the horn can frequently be seen separating around the coronet in a downward direction in sheep and pigs. Very young calves may die from enteritis (inflammation of the bowel) without showing external eruptions.

Animals usually recover from foot-and-mouth disease, but the loss, owing to depreciation, loss of milk, or permanent injury, is considerable. Some outbreaks, however, are more virulent than others, and in a very virulent outbreak a considerable number of animals may die, usually from intestinal complications.

Infection.

The contents of the vesicles are infective, and therefore material contaminated thereby, such as saliva, hides, foodstuffs, litter, dung and milk, will also be infective. The blood has only been found to be infective in the earliest stage of the disease.

The virus of this disease is easily destroyed by antiseptics, and by such natural processes of disinfection as drying and sunlight. There can be no doubt, however, that under certain conditions which exist in nature, but which are not fully known, the virus may remain active for months, and may be carried long distances. This probably accounts for the mysterious outbreaks which have occurred in Great Britain without apparent relation to a previous case. A comparatively low temperature—55° to 70° C. (131° to 158° F.)—destroys the virus.

Infection is spread from animal to animal by the fact of the animals being together in stables or on the pastures, or by the hands of milkers, or by the hands, boots or clothes of other attendants. It may be carried considerable distances on foodstuffs, and through a water supply being contaminated. When an animal is salivating, the threads of saliva and straws contaminated thereby may be blown a considerable distance by the wind, and thus reach other animals, or a watercourse from which they drink. The roads along which affected animals have passed, and the wagons in which they have travelled, may remain infective for some time. Rats, owls, birds, cats, horses and dogs may act as mechanical

carriers of infection. It is also conceivable that human beings affected with the disease might convey it to animals. The spread of infection from place to place is most insidious. A good deal of evidence has been collected which goes to show that a human being may, through his clothes, make the clothes of others infective. There is also a considerable amount of evidence that some animals which have recovered from the disease may be infective to others for a considerable time after recovery. The virus enters the body through the mucous membranes, and probably the commonest method of infection is by way of the alimentary tract. A very small amount of the material from the vesicles (1/250th of a drop) has been found sufficient to cause infection.

Prevention.

It is not intended under this heading to deal with prevention in the sense of administering so-called preventive drugs, or resorting to preventive inoculation. There is no drug known which renders an animal resistant to foot-and-mouth disease, and science has not so far provided a practicable method which can be used to immunise animals artificially.

If the disease breaks out on any premises it is the duty of the owner to take all reasonable measures to prevent the affected or suspected animals, and those in immediate association with them, from coming in contact with those of his neighbours. Affected stock should be kept away from a public road, from a water supply which reaches other farms, and from boundary fences immediately beyond which other stock are pastured. The attendants should be warned not to go amongst other cattle, sheep, goats, or pigs, and all persons who have to leave the premises should disinfect their boots before doing so, otherwise they may carry infective material on to the roads or elsewhere. The boots should be scraped to remove particles of manure, and afterwards they should be swabbed with an ordinary disinfecting solution. If such is not available a saturated solution of common salt in hot water may be used. Milk should not be allowed to leave the premises, nor should it be given to other animals on the premises, unless it has been previously boiled. Dogs and poultry should not be allowed to roam at large.

The above precautions apply mainly to the owners of infected premises and any persons for whom they are responsible. It may happen, however, that other owners or their employees may find themselves on suspected premises before an outbreak has been declared. In such circumstances they should carry out the above-mentioned

measures of disinfection, and they should refrain from attending to other animals until they have further disinfected their hands, and changed their boots and clothes.

Reporting the Existence (or Suspected Existence) of the Disease.

The attention of stockowners is directed to Section 4 of the Diseases of Animals Act, 1894, and Article 1 of the Foot-and Mouth Disease Order of 1895, which in effect provide that every person having or having had in his possession or under his charge an animal affected with or suspected of foot-and-mouth disease shall with all practical speed give notice to a police constable.

The object of immediately reporting any suspicious case is to enable the authorities to have immediate inquiry made, and, if disease is found to exist, to isolate it, and stamp it out before it can extend throughout the country. As the result of the disease spreading in 1869, it persisted in Great Britain until 1872, and it is estimated that 3,000,000 animals were attacked. An estimate was made of the losses sustained from the disease between 1870 and 1877 in Northumberland and Westmorland alone; in that period there were 9,035 outbreaks in these two counties, 236,755 animals were involved, and the loss was about £301,400.

The disease spread again in 1881–1884. In Great Britain 26,484 outbreaks occurred and 710,362 animals became affected, of which 9,361 died and 5,874 were slaughtered.

Figs. 1 and 3 are from the Report of the Departmental Committee on Foot-and-Mouth Disease [Cd. 7270.] (London: Wyman & Sons, price 4½*d.*)

Whitehall Place, London, S.W.,
September, 1915.

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Leaflet No. 293.

BOARD OF AGRICULTURE AND FISHERIES.

Soil Analysis.

Inquiries are frequently received by the Board from farmers and gardeners who wish to be informed where they can have soils analysed. In most cases the idea appears to be entertained that having a soil analysed is a ready means of determining its manurial requirements or of obtaining an indication of its fertility. A brief discussion as to how far this view is correct may therefore serve a useful purpose.

A complete soil analysis includes chemical, physical and bacteriological investigations, and may be accompanied by general field observations for the purpose of ascertaining the nature of the subsoil, the water supply, and climatic and other conditions important for the growth of plants. A full investigation of this kind, however, is very laborious, and in practice the analysis is usually less comprehensive, and aims not so much at giving a complete account of the soil as at determining the amounts of certain substances present in the soil which are known to have an important effect on crop production.

Experience has shown that a soil analysis is of little practical value when the interpretation is based on the results obtained from an isolated sample of soil from a district of which the analyst has no intimate knowledge. In certain special cases, *e.g.*, where it is required to determine whether a soil is in need of liming, an analysis may be of great assistance to the farmer, but even where the investigation is a comprehensive one the analyst can only give a very incomplete idea of the general fertility of a particular field. It is difficult to place an absolute value on the results, and the element of uncertainty enters too largely into the interpretation. The difficulty will be appreciated if an attempt is made to obtain information as to the best system of manuring.

The analyst can determine as accurately as need be the percentages of nitrogen, phosphates and potash in the soil, but it has been found that, even where external factors such as climate, depth of soil, etc., do not enter into the case,

there is often little or no connection between these percentages and the soil's fertility or its manurial requirements. Any ordinary soil contains much more total plant food of all forms than a single crop of any kind can possibly require. Most of this plant food, however, is in a condition in which the plant cannot make immediate use of it, and is only gradually made available, the rate varying in different cases. As the plant can only make use of the free or available food, it is clear that it is possible for one soil containing quite small amounts of the manurial substances to produce better crops than another soil containing large quantities, if for any reason the first soil gives up its material to the plant at a more rapid rate than the second. In fact, some soils contain large quantities of nitrogen and still respond most readily to small dressings of manure containing available nitrogen, because practically all that is already in the soil is unavailable and as far as the plant is concerned might almost as well not be there at all. This also holds equally for phosphatic compounds ; a soil may contain a good deal of phosphate and yet respond to more.

It is true that in the case of phosphates and potash a method has been devised of roughly measuring the amount which may be regarded as of immediate or prospective value to the plant, by ascertaining the quantity which is dissolved out in a given time by a weak solution of citric acid. This method gives results which in many cases indicate fairly well whether a particular soil will respond to an application of either of the two kinds of manure, and may be used in comparing soils of the same class. At the same time there are many cases where the results obtained are at variance with those obtained by actual experiment in the field, and so far no ready method has been discovered by which the availability of the nitrogen in the soil can be estimated, except as regards the small amount present in the form of nitrates or of ammonium salts. It will be seen, therefore, that chemical analysis of an isolated sample of soil can hardly be expected to supply a very accurate and reliable means of determining its manurial requirements, and it is probable that a simple field experiment would yield better results.

It is not only a question of what the soil contains but also of what the plant needs. A plant is a living thing and its needs are not constant but vary with the conditions under which it is grown. Thus a plant *needs* more phosphates on a clay soil than it would on a sandy soil, and it *needs* more potash on a sandy or peat soil than on a loam. Again a plant growing in a district receiving 32 or more inches of rain is in greater need of phosphates than in districts with less than 24 inches of rain.

Further, under present conditions an isolated mechanical analysis cannot be considered of much value to the farmer. By means of a mechanical analysis it is possible to measure the proportions of particles of different degrees of coarseness in the soil, and so determine to some extent the ability of the soil to meet the plants' requirements as regards the supply of water and the proper aeration of the soil. At present, however, it is probable that an experienced farmer would be able to gain more useful and accurate information by examining the land carefully at different times of the year.

Directions in which a Soil Analysis may be Useful.

While isolated soil analyses are of little practical value at present, there are one or two directions in which an analysis can afford useful assistance.

1. A farmer may wish to know whether he has any reasonable chance of obtaining results similar to those demonstrated by field experiments on another farm in the locality. Where such experiments have shown the advantage of applying lime, phosphates or potash, the analyst can determine whether similar results are likely to be obtained on the soil which he analyses. The element of uncertainty will always be present, but there is every prospect that the advice will prove to be correct. In this way the farmer may be saved much time and expense in carrying out the experiment for himself.

2. A soil analysis may also prove of assistance where a farmer proposes to introduce a system of cropping or tillage known to give good results elsewhere in the locality, but before doing so wishes to compare his soil with that on which the system is successful. Analysis may reveal differences which although not obvious to casual inspection are of vital importance to the success of the enterprise. Two heavy soils, for instance, may look very similar, but one may owe its heaviness to very fine particles, and the other to silt particles, and methods successful in one case may prove failures in the other.

3. A farmer entering a new farm may wish to obtain complete information as to the possibilities of the soil, with a view to taking up some special branch of production, or ascertaining for what special crops the soil is suited. A soil analysis will show whether the soil and general conditions resemble those obtaining where the proposed system of farming is known to be a success. Where important differences are revealed the farmer may be able, with the assistance of the agricultural expert, to modify the scheme so as to adapt it to the possibilities of his soil.

It will be gathered from the above notes that the maximum assistance can only be obtained from a soil analysis when data are available for comparison with soils of the same type. Fortunately the country is now provided with organised schemes under which systematic investigations may be made and the results recorded. Soil surveys supplying fairly full information with regard to special classes of soil in a limited area, and carefully conducted field experiments, are being carried out in many parts of the country. As time goes on therefore, the possibility of setting up comparisons will steadily increase and analyses will be of correspondingly greater value.

Before deciding to have a soil analysis carried out the farmer should apply to the County Agricultural Organiser,* who will advise him whether material for a comparison is available and whether the analysis would be likely to give useful results.

* A list of County Agricultural Organisers is given in Special Leaflet 25 (*Technical Advice for Farmers*).

Whitehall Place, London, S.W.,
October, 1915.

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Leaflet No. 294.

BOARD OF AGRICULTURE AND FISHERIES.

Poultry Houses and Appliances for Allotment Holders, Cottagers, and Others.

Simplicity of construction, mobility and economy of material are the desiderata in houses, runs, and appliances used by poultry-keepers of all classes. Some reference to this subject is made in Special Leaflet No. 3 (*Poultry on Allotments and Garden Plots*), but fuller information is desirable, especially in regard to plans and methods of construction.

Fowl houses can be built inexpensively when time is available for the necessary work. Timber already used for other purposes is often at command, or may be purchased cheaply, and, in the neighbourhood of great centres of population, large packing cases can sometimes be bought at low prices. Timber merchants are often able to sell cheaply such cuttings and shorter lengths of deals as are not generally required by their customers, and which can be fitted together for boarding the walls and roof of the poultry house, or for making coops and runs. It is necessary, and is usually most economical, to buy new scantling for the framework of the house; the cost of this, however, bears a small proportion to the whole.

General Principles.

In building a poultry house the following important points should be observed :—

(1.) With regard to material the timber should be sound and dry. The cost of deals is largely governed by the extent to which they have been seasoned. If newly cut there will be shrinkage and warping as the natural moisture evaporates. It is, therefore, true economy to pay, say, 10 or 15 per cent. more for thoroughly seasoned wood.

(2.) Narrow deals are cheaper than broad ones.

(3.) Deals are sold by timber merchants by the square, that is, with a surface of 100 sq. ft.; scantling for framework and joists is sold per 100 ft. run.

(4.) In regard to construction the back, two sides and roof of the house should be solid, and air and water-tight. For this purpose well-seasoned, tongued and grooved deals are preferable, if tightly clamped together. These should be fixed to the frame perpendicularly. If fixed horizontally special deals must be used, each overlapping that below.

These are more expensive, having to be specially cut, and a larger amount of timber is required.

(5.) Ventilation must be adequate. It is best secured by making the house, which should always be the maximum height in front, what is called "open-fronted," that is, a space 15 to 30 in. above the floor should be boarded and the rest covered with wire netting. This ensures a constant circulation of air without draught. The inmates are quite comfortable even on the coldest night, and the air is not at such times saturated with moisture, which is the case if ventilation is insufficient. To prevent rain driving in, a sloping or sliding shutter should be fixed outside. Open-fronted houses do not usually need windows, as the lighting is abundant. Sunlight purifies the atmosphere and kills many forms of organisms.

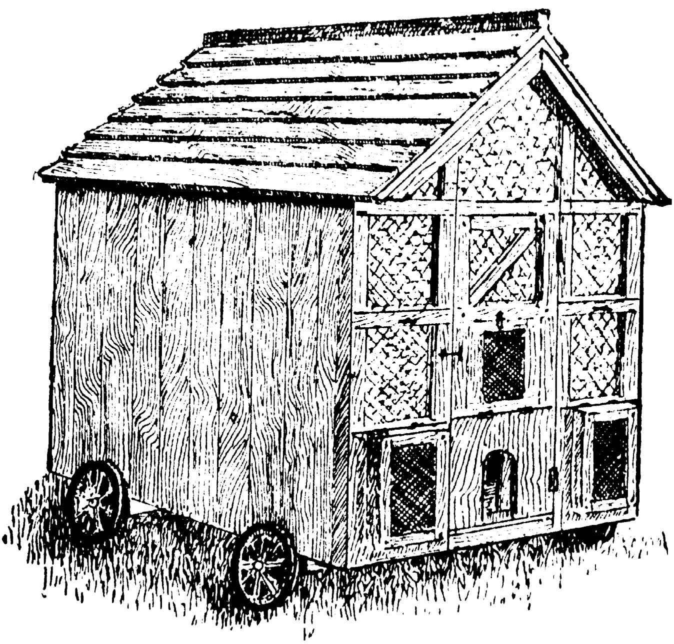

FIG. 1.—Field House for 20 Birds.

(6.) The internal fittings should be as simple as possible, and capable of easy and immediate removal. Perches may be made of 2 in. by 2 in. scantling with corners smoothed off, resting on supports fixed to the sides, 15 in. to 2 ft. above the ground in portable houses, or 3 ft. above the ground in fixed houses, with, in the latter case, a dropping board below, in order to give a greater amount of scratching space. Nest

boxes in portable houses should be raised 12 in., and one compartment should be allowed for every four or five hens. With a little alteration orange boxes are excellent for this purpose.

(7.) Cleanliness is supremely important. The whole house—roof, walls and floors—should be regularly brushed over ; nesting materials should be renewed frequently ; and lime washing or spraying with a good disinfectant twice a year is essential.

Types of Houses suitable for Allotments and Gardens.

On the larger allotments or small holdings, that is, such as approach five acres in area, where the fowls are not kept within enclosures of wire netting, and have, therefore, a measure of liberty, what is known as a portable or field house should be employed, either upon wheels or on runners, so that it can be removed frequently in accordance with methods of cultivation, or to prevent injury to the grass. Figure 1 illustrates a suitable type of such a house.

What is known as the Colony System can be recommended upon allotments, that is, one-fourth the ground available is devoted entirely to the fowls for a year. It is enclosed by wire netting, which is removed bodily to enclose another similar area, the process being repeated annually, and forming a four-course rotation. Under such conditions, especially if the enclosed areas do not exceed an acre, a scratching shed house is desirable to afford abundance of shelter and provide exercise, the grain being scattered among litter on the floor. On larger areas, especially if the land is arable, a scratching shed is not required.

On garden plots, and where by reason of the limited amount of land available the runs must be small, the scratching shed system is also advised, the size of house being varied with the number of inmates. Figures 3 and 4 give illustrations of a scratching shed house. Upon garden plots and where land is very limited double runs should always be used.

Specification of Apex Portable Poultry House.

In houses which must be moved frequently it is essential that the frame should be strong to stand the strain, or it may soon come to pieces. The joints should, in all cases, be tightly mortised, and where cross stays are used the ends should be cut and fitted into corresponding grooves in the uprights, as nailing does not afford sufficient resistance to the strain.

An apex house on similar lines to that illustrated in Fig. 2, may be 5 ft. wide, 6 ft. long, and 6 ft. high to the

point of the gable, with side walls $1\frac{1}{4}$ ft. high, and boarding in front $1\frac{3}{4}$ ft. high. The capacity is 15 adult fowls, or 20 growing chickens. Roof, sides and back are solid, except

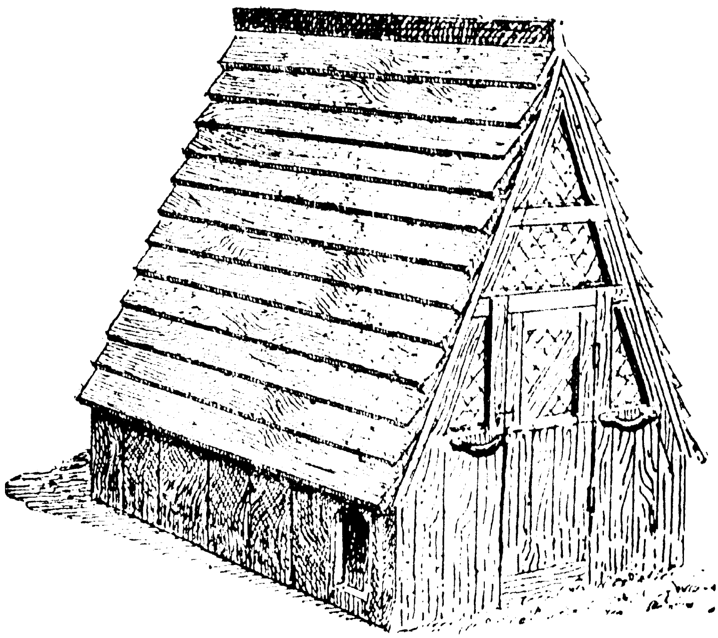

FIG. 2.—Apex House for 15 Birds.

that a door is made in the last-named. The front consists of boarding $1\frac{3}{4}$ ft. from the ground, with 1 in. mesh wire netting above, and a triangular shutter. The roof may usefully be carried a foot beyond the front.

Material used.—Scantling for frame, 2 in. by 2 in.; to reduce weight, 2 in. by $1\frac{1}{2}$ in. may be used, but the heavier material should be used for the sills or bottom frame. Boarding, white deals, 5 in. by $\frac{3}{4}$ in., tongued and grooved. Wire netting for front, 1 in. mesh. One pair of 9 in. hinges and lock or catch for door; a supply of $1\frac{1}{2}$, 2 and $2\frac{1}{2}$ in. French nails; optional, guttering and felting for roof (*see* below).

Frame.—Front: 2 lengths, 5 ft. each, for sill and cross; 2 lengths, 6 ft., for roof; 2 uprights from roof stays to sill, 1 ft. 3 in. each; 1 cross tie, 2 ft., below apex. Back: 1 length, 5 ft., for sill; 2 lengths, 6 ft., for roof; 2 uprights, 1 ft. 3 in.; 1 cross tie above door; 2 uprights, 4 ft. 6 in., for door space. Roof: 3 lengths, 6 ft. 6 in. Sides: 4 lengths,

6 ft. Floor: 1 length crosswise 3 ft. from each end, 5 ft. Two perches, each 5 ft. long, will be required. The total is 116½ foot run.

Match boarding should be firmly nailed upon the frame. Allowance has been made for the roof to project 3 in. at either end, but a projection of a foot at the front end is better. The timber required will be as follows:—Front, boarded 21 in. up, 8¾ sq. ft.; back, inclusive of door and cross pieces of the same material, 21¾ sq. ft.; sides, 15 sq. ft.; roof, 78 sq. ft.; and floor, 30 sq. ft.; total, 153½ sq. ft., or with allowance of 24 sq. ft. for nest boxes, 177½ sq. ft. in all.

To prevent the entrance of rain at the apex of the roof a cap should be made, planed and carefully jointed, from 6 ft. by 6 in. boarding cut down the centre; or iron guttering can be bought cheaply and fitted upside down; or if the roof is covered with felting, one length may be nailed over the apex.

Where the door is placed at the back it must fit tightly to prevent draughts, otherwise it would be better to make the front into a door, either wholly or partly. An excellent plan is to nail a strip of wood outside all around the door, overlapping 1½ to 2 in. on to the wall against which it closes.

If the house has to be moved frequently wheels should be attached. In this case 3 × 3 in. wooden beams should be bolted right across the under frames of the house a foot from either end, to which the axles are attached, or stout iron axles 6 ft. long may be employed. The wheels should be not less than 9 in. in diameter with a 2 in. tyre. An alternative is to use runners fixed lengthways with ends curved upward. These should not be less than 6 in. broad. A horse is required for removal where runners are employed.

The two perches should be fixed at the back 15 in. above the floor and 18 in. apart.

The nest boxes should be removable, 15 in. square, 12 in. high, and without bottoms, standing upon the floor or upon the ground under the dropping board. If in sets the partitions and ends alone need be solid, as strips of wood back and front keep them firm.

Thorough creosoting or tarring outside will preserve the wood, and tend to keep down parasites. It is an economy to cover the roof with felting.

Specification of Scratching Shed Poultry House.

Houses of this class are permanent or semi-permanent, that is, they are not intended to be moved, and are therefore built with a rigid frame. If they are used for colony flocks,

and are to be removed occasionally, the better plan will be to erect them in sections, that is, the roof, back, front, and sides should be made separately and bolted together. In that case 23 ft. additional scantling and the necessary bolts and nuts will be required. For moving purposes it is a useful plan to fit the house with axles from which the wheels can be removed when the house is in position, one set of wheels thus serving for several houses. For this form the shed type is to be preferred as illustrated in Figs. 3 and 4.

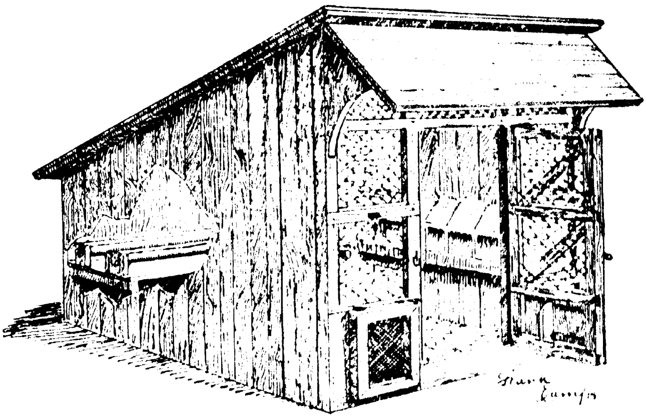

FIG. 3.—Scratching Shed House for 16 Birds.

A useful size is 8 ft. square, 6½ ft. high in front, 5 ft. high at back; the roof, back, and ends solid; the front, in which is a door, boarded up 2½ ft., with wire netting above and a fixed shutter in front 2 ft. deep as a rainguard. The capacity of such a house is 16 adult fowls, providing 3¾ square feet of floor space for each bird.

Materials used.—Scantling for frame 2 in. by 2 in.; boarding, white deals, 7 in. by ¾ in., tongued and grooved; wire netting in front, 1 in. mesh; one pair 4 in. butt hinges for door, and lock or catch; a supply of 1½, 2, and 2½ in. French nails; 24 ft. run of felting for roof; and 9 ft. of guttering to be fixed at back of roof, with the necessary supports.

Frame.—Front: two uprights, 6½ ft. each; two horizontals, 8 ft. each; 4 horizontals, 2 ft. 9 in. each; two uprights for door posts, 6 ft. each; frame for door, 19½ ft. Back: two uprights, 5 ft. each; three horizontals, 8 ft. each. Two ends: two to support roof, 8½ ft. each; two horizontals, 8 ft. each. Roof: one cross tie, 8 ft. Two perches, each 8 ft. The total is 162½ ft. run. A little allowance must be made for shaping the tops of the uprights for the slope of the roof, and for supports of the dropping board under the perches.

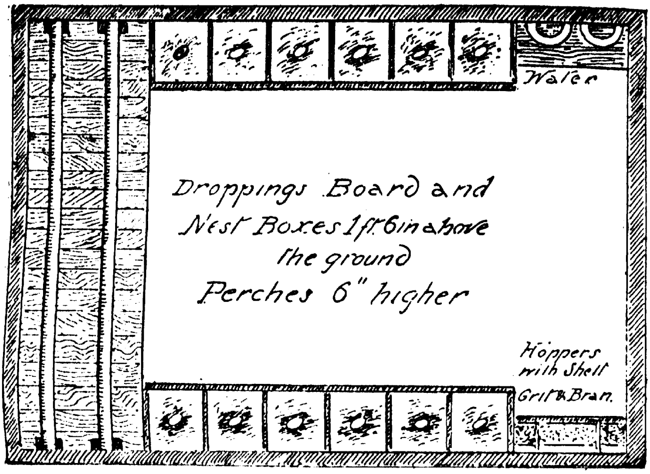

FIG. 4.—Ground Plan of Scratching Shed House for 16 Birds.

Match boarding required will be :—Front, boarded up 2½ ft., including door, 20 sq. ft. ; back, 40 sq. ft. ; two ends, 92 sq. ft. ; roof (allowing to project over all round), 76½ sq. ft. ; shutter, 8 ft. by 2 ft., 16 sq. ft. ; dropping board, 7 ft. 10 in. by 2 ft., 16 sq. ft. ; nests, 30 sq. ft. ; or 290½ sq. ft. in all.

In this form of house a floor is not necessary. Where the house has not to be moved it is an excellent plan to place a course of bricks under the walls and fill in the space with sand, or gravel, or earth well beaten down.

The perches and nest boxes may be similar to those for the apex portable house, and the timber may be similarly treated.

Dust Bath.

Where fowls are on range or in large runs and the ground is broken no provision need be made for a dust bath. If they are kept in small runs, however, a dust bath is essential in order to enable the birds to keep themselves free from parasites. An excellent form, triangular in shape, may be fitted into a corner of the house or run. Where used under cover it only requires to be boarded 6 in. high all round, forming a movable box with three equal sides. The cover prevents the birds roosting above. If used outside it should be made with solid sides, leaving the front open above the retaining boards. One or two sugar boxes, which can be bought for a few pence, contain enough material for making an indoor or outdoor dusting box as the case may be.

Coops

Many and varied forms of coops are used. Simplicity is both desirable and economical. A useful coop can be made from a sugar box. The lid should be taken off. One side of the box will form a floor, and the other should be removed. Two of the lid strips should be cut into long sloping pieces, 3 in. at the front down to 1 in. at the back, and be fastened on to the open side by two pieces within at either side, so as to hold them firmly. The laths removed from the open side must be nailed across the sloping pieces, and with a strip from the lid will make the top, having the requisite incline to carry off the rain, although it will be made watertight by a piece of felting or corrugated iron nailed over. Enough of the lid will remain to cut into bars 2 in. wide, to be fixed 2 in. apart, for the front; two bars should be loose for letting out the hen and cleaning. A coat of gas tar will preserve the wood.

Whitehall Place, London, S.W.,
April, 1915.

Copies of this Leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 295.

BOARD OF AGRICULTURE AND FISHERIES.

Marketing of Eggs.

Although their proximity to consuming centres places British producers of eggs in a much more favourable position than their continental competitors, unsatisfactory methods of marketing have prevented them from reaping the full benefit of the advantage. The complaints of retailers that home supplies of eggs are less reliable than, and often inferior to, the better grades of the imported supplies are unfortunately too often justified. It is true that during recent years there has been a marked improvement in the methods of marketing. The establishment of egg collecting depôts has demonstrated the benefit of marketing on co-operative lines, and the work of itinerant poultry instructors has led many poultry keepers to adopt better methods. It is probable, however, that by far the greater number of eggs produced in this country still reach the consumer lacking in one or more of the qualities which indicate a first-grade egg. This state of things contrasts unfavourably with the steps taken by foreign shippers to improve the quality of the eggs placed on the British market, and is the more unfortunate because the introduction of a more efficient organisation for marketing would enable the British producer to take full advantage of his position. No foreign eggs can be marketed in this country under four days, and the number imported so quickly is very small indeed ; it appears probable that the demand for eggs fresher than this is practically unlimited and is restricted to native supplies.

The Egg Standard.

The consumer unconsciously plays an important part in fixing the standard for the first-grade egg. Popular prejudice may not always be supported by scientific fact, but, as the consumer is ultimately responsible for the demand, the producer will find it to his advantage to study public requirements carefully and endeavour to meet them as far as lies in his power.

Age of the Egg.—The interval between the time the eggs are laid and the time they reach the consumer should not be more than three to five days, according to the season of the year. If older than this they must face competition with foreign supplies, and have lost a measure of their new-laid quality. With things as they are at present delay in marketing is traceable to the dealer or retailer as well as to the

producer. Unless the poultry keeper delivers his eggs to private customers he loses control of them after they have passed out of his hands, but he can at least ensure that he is responsible for no part of the delay.

External qualities.—The egg should be not less than 2 oz. in weight; eggs weighing less than 2 oz. may be of equal nutritive value but the consumer has an undoubted preference for those of larger size. In shape it is desirable that the eggs should be neither too long and narrow, nor too short and wide; provided, however, the shell is even and not abnormal this does not matter greatly. The shell should be strong and devoid of any roughness. A thick shell may mean that the proportion of edible matter to total weight is less than when the shell is thin, but this is more than compensated for by the fact that there is less evaporation and the transport qualities are greater. Roughness of the shell is to be avoided, as in autumn and winter it generally denotes preservation by lime water. The bright, shiny coating of the egg known as "bloom" should still be present.

While it may be true that there is no appreciably greater value in eggs with tinted shells the consumer usually prefers them to those having white shells, and the producer should therefore include at least a proportion of tinted eggs in his consignments. The production of tinted eggs is dealt with in Leaflet 129 (*Winter Egg Production*).

Internal Qualities.—While it is important that eggs should present an attractive external appearance, their actual food value can only be determined by an examination of the contents. Examination should show a small air space at the broader end of the egg. When an egg is new-laid the air space is scarcely perceptible, but it increases in size every day. The contents of the egg should be clear and free from spots representing moulds, or dark areas showing development of the germ.

When broken the white and yolk ligaments should be strong and firm and the yolk round. A flat yolk indicates age or a "stale" egg. The best yolks are reddish-yellow in colour, and not pure yellow. If boiled before it is more than three to five days old the white does not thicken to the extent that it will later, but remains milky and flaky.

Finally, it may be said that infertile eggs are to be preferred to those which have been fertilised.

Measures for Improvement.

When the poultry-keeper fully realises the qualities which characterise a first-grade egg he should not find it difficult to make his produce conform to the standard. The general management of poultry for egg production is dealt with in

Leaflet 114 (*Feeding of Poultry*), and Leaflet 129 (*Winter Egg Production*), but, from the point of view of marketing, the following points may be emphasised.

Breeding.—To ensure a regular supply of eggs throughout the year it is desirable to keep two breeds of hens, one a non-sitting breed, and one kept for general purposes. The general purpose breed should provide the necessary proportion of tinted eggs. Many strains of poultry at the present time are inclined to lay rather small eggs. To remedy this care should be taken to breed only from hens laying eggs of the requisite size, and to select eggs for hatching that are of the desired weight.

Nests and Cleanliness.—Nests should be sufficient in number, roomy, dry and clean. They should be removable to facilitate cleaning and the nesting material should be renewed frequently, especially if it becomes wet or soiled. If, in spite of every precaution, dirt has collected on the egg, it should at once be removed by means of a dry cloth. Should that not be sufficient a slightly damped, but not wet, cloth may be used. It is desirable to lime-wash the nests frequently, to keep them free from parasites.

Collecting and Storing the Eggs.—The eggs should be collected at least once daily; in warm, moist weather twice daily is preferable. They should not be kept in a hot room or exposed to the sun's rays. The store room should be cool and dry, and free from objectionable odours. A dairy is excellent for the purpose, but failing that a larder or well ventilated cellar would be suitable. It should be remembered that few food products are more susceptible than eggs to taint by strong smelling substances, and to rapid deterioration when improperly stored.

All abnormal eggs, double-yoked, large, dirty, small and cracked eggs should be utilised for home consumption.

If it can be avoided fertile eggs should not be marketed. In warm, moist weather they may undergo partial incubation, and, in any case, form the great mass of bad and deteriorated eggs. The male birds should be removed directly after the close of the breeding season.

The practice of holding back eggs in the hope of obtaining a higher price cannot be too strongly condemned, and is against the interests of the producer in every way. Eggs should be marketed at least once a week; if the highest class trade is to be secured they must be marketed three times a week in spring and summer, and twice a week in winter.

Packing.

Sectional egg boxes, which are returnable, are generally used in this country by all classes of dealers and co-operative societies. They vary in detail, but are similar in

principle. The return of cases involves a large amount of trouble, annoyance and loss, and retailers generally prefer non-returnable boxes. The question is chiefly one of cost. A sectional non-returnable box holding three long hundreds could not be made, even in quantities, for much below two shillings. On the other hand a strong returnable case holding the same number may be purchased for 6s. and with small repairs and renewals of fittings could be used for at least a hundred journeys. Even adding the cost of returning, the saving to the sender is considerable. The principal advantage of non-returnable cases is that the fittings are new and, therefore, will be perfectly clean, while this is not always the case with those which have been frequently used ; as eggs are so susceptible to external influence and are easily tainted, this is an important point. If they are encased for some hours or days in boxes with the fittings damp and dirty the eggs will soon deteriorate. The fresher and better the egg the more easily is it affected in this way. It is advisable to renew the cardboard fittings and dividing sheets from time to time.

During hot weather persons who are conveying eggs to the market or railway station should see that the boxes are not exposed to the full glare of the sun. Vans in which they are carried should be well ventilated.

Treatment of Eggs in the Markets and by Retailers.

Many of the old market buildings in country towns, where eggs and butter were brought for sale, were cool and therefore well suited for perishable products such as eggs. Some of these still remain, but it frequently happens that eggs are now sold in the open market quite irrespective of the weather. Not only is this so but the eggs are also packed under the same conditions. Exposure to bright sunshine or rain during packing must lead to deterioration, and were it not that the journey is frequently a short one, the damage would be considerable. The more careful local traders recognise this, and whenever possible, pack under cover in a cool place. In all local markets suitable rooms should be provided for packing eggs.

The retailer also often fails to realise the perishable nature of the eggs which he offers for sale. It is true that the eggs do not usually remain long in his possession, but they may undergo rapid deterioration, even in a short time, by being placed in hot shop windows exposed to the sunlight during the day and to radiation from gas jets at night. The eggs should be kept in a cool place removed from any strong-smelling goods. Special care should be taken to store eggs in suitable places overnight and during week-ends.

Testing and Grading.

Grading.—The greatest obstacle in the way of improvement in the marketing of eggs in this country is the present practice of selling on a basis of quantity rather than quality. It is quite a common occurrence for eggs delivered as new-laid country eggs to include a large proportion of second grade and even stale eggs. With a system of grading this would not be possible. On the Continent and in Ireland eggs are graded into three sizes (firsts, seconds and thirds), and the inferior and small eggs are retained for sale locally. Such a system, efficiently carried out, has numerous advantages, of which the following may be mentioned. Poultry keepers whose aim is to produce only eggs of the best quality would obtain an increased price, and retailers could make their purchases with the knowledge that the eggs are what they are stated to be. Uniformity in size means that supplies of graded eggs will present an attractive appearance, and also that there is less risk of breakages in packing. With the prospect of obtaining increased prices there would be a tendency in the direction of a general improvement in the quality of the eggs produced.

Testing.—A system of grading can only be successfully carried out with the assistance of accurate testing. Inefficient testing will lead to confusion and largely defeat its own ends. Facility in testing can only be acquired by practice, and for this reason it is desirable that the operator should devote the greater part of his time to the work. Testing is therefore best undertaken when there are large quantities of eggs to be dealt with, as, for example, at a Co-operative Egg Depôt and in the local market. The test might take place where the eggs are purchased from the producers, who could then be paid on the basis of quality, and not on the present system of all-round prices. No greater stimulus could be given to the production of first-class eggs. Testing and grading are already leading features of the improvements in handling introduced by co-operative societies, and are also being adopted by better class local traders, and accommodation should be provided for the purpose at all local markets. If this were done retailers could then purchase with confidence from local collectors, who, by giving enhanced prices to reliable producers, would in their turn compel other poultry keepers to aim at reaching the same standard.

It is necessary to emphasise the necessity for grading and testing to be carried out in such a way that the guarantee of quality can be accepted without hesitation. The importance of this is well recognised in some Continental countries

and in British Colonies where proposals are being made for a control system by which an official grader and tester would be employed.

In any general improvement in the conditions under which eggs are marketed much might be done by an extension of co-operative principles (*see* Leaflet No. 111, *Co-operative Egg and Poultry Societies*). Co-operative societies can introduce efficient methods of grading; they can serve much wider markets than the individual poultry keeper, and they can maintain steadier prices when eggs are plentiful. Co-operative marketing, however, is still the exception rather than the rule in this country, and the incentive to produce the best class of eggs is often lacking. Every effort should therefore be made to improve the existing machinery, both by the adoption of more systematic and expeditious methods of forwarding from producing to consuming centres, and by the introduction of an efficient system of testing and grading.

Whitehall Place, London, S.W.,
November, 1914.
Revised, June, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 296.*

BOARD OF AGRICULTURE AND FISHERIES.

Potato Growing in Allotments and Small Gardens.

At the present time many householders will be especially anxious to curtail their domestic expenses by devoting increased attention to the cultivation of vegetables in their gardens and allotments, and all available land may in some cases be used for growing vegetables. In such circumstances few vegetables can be planted more profitably than the potato, and the following suggestions are offered for the benefit of those who can devote only a small area of land to this vegetable.

The Soil.

Growers on a small scale can seldom choose the soil in which to plant, but they may do much to enable such soil as they have to produce a satisfactory crop. Potatoes do best in moderately light soil with good drainage. When heavy land must be used it should be thoroughly dug over during the autumn and winter, and should be prevented from becoming water-logged by being thrown up in ridges or narrow stetches if necessary. Twitch (couch grass), docks, nettles, or other perennial weeds should be forked out, and if there is any reason to suspect that leather jackets (grubs of the daddy long-legs), wireworms (grubs of the click beetles), or millepedes (also known as false wireworms) are present in large numbers, the land should be repeatedly turned over as far as the weather permits. If the land is sandy or open in texture it may be improved by adding "humus," that is anything in the nature of dead leaves or decaying vegetable matter. Impoverished land should be enriched with stable or farmyard manure, which may be dug in during autumn or winter, or before planting in spring.

Lime should not be applied in large quantities to land on which potatoes are to be the next crop, as it may induce scab. Nevertheless, small quantities (say 7 lb. per rod) are beneficial in rich garden soils; and on heavy soils, or soils that have lain in grass for some years, 14 lb. of lime per rod may be applied. Lime corrects acidity and improves the texture of clay (*see* Leaflet No. 170).

Time of Planting.

If the soil is in reasonably good condition, potatoes may be planted as soon as mild weather arrives in spring. If,

* This leaflet was previously issued as Special Leaflet No. 18.

however, wet weather has made the preparation of the soil difficult, planting should be deferred for a time. It is better to plant at the end of April with the land in good condition than early in March with the land in bad order.

In a very few districts potatoes may be planted in February, but March and April are the usual months, the former for the early varieties, the latter for the main crop.

Selection and Preparation of "Seed."

Seed potatoes of a suitable size should be procured, or saved from the previous crop, provided it has been a satisfactory one. It is undesirable to plant the very small potatoes known as chats, or the largest tubers, except in the case of first early varieties. In the case of earlies, seed potatoes should not as a rule be cut. As potatoes lose their vitality if grown continuously in the same locality, frequent change of seed is recommended, and experience has shown that it is better to obtain seed tubers from a district farther north than that in which they are to be planted. It is customary with the best growers to procure new seed every alternate year from Scotland; in recent trials, however, Irish potatoes have sometimes given as good results as Scotch. In the warmest and driest districts a change is desirable every year.

All potatoes intended for seed should be carefully "boxed." Boxing is done by placing the seed potatoes in layers in shallow boxes, and keeping them in a dry shed or other place where they are exposed to light and air but not to frost. They then "green," and ultimately form two or three short strong shoots which produce more vigorous plants than potatoes which have been kept in the dark till they are planted. Large growers are often unable to box the later varieties owing to want of space, but small growers are advised to box all seed potatoes, though it is more important to box the early than the late varieties.

Diseased potatoes should on no account be planted.

Manuring.

The potato is a gross feeder, and a liberal supply of readily available plant food is necessary for the production of a large crop. When it can be obtained, perhaps the best source of such food is farmyard manure, or, failing that, town stable manure. When such is available it should be used at the rate of 15 to 20 tons per acre—say 2 to 2½ cwt. per rod. (A large wheelbarrow holds about 1 cwt.) On heavy land it may be useful to apply the dung when digging the ground in autumn or winter, but on very light soils dung, moistened if necessary, may best be applied shortly before planting the tubers.

Alternatively, 1¼ cwt. of dung per rod may be applied, and at the time of planting ¾ lb. to 1 lb. of sulphate of ammonia, 2 lb. to 2¾ lb. of superphosphate and ½ lb. of sulphate of potash, when available, may be added. At the present time superphosphate is difficult to obtain. If possible, at least half of the normal quantity should be applied and this should be supplemented by either 1¾ lb. of steamed bone flour or 2 lb. of basic slag or Gafsa mineral phosphate. In place of the ordinary potash dressing ashes from wood or vegetable matter may be used at the rate of 2 lb. per rod (*see* also Special Leaflet No. 42, *Potash Supplies during the War*).

If no dung is available good results will usually be obtained by the application at planting time of 1½ lb. to 2 lb. of sulphate of ammonia, and 4 lb. of superphosphate per rod, or half this quantity supplemented by double the quantities of the other phosphatic manures mentioned above. In addition, twice the normal quantity of ashes already mentioned should be applied.

Method of Planting.

The depth and distance apart at which potatoes should be planted vary according to the soil and the climate, but generally speaking potatoes should be planted fairly shallow. Where the soil is light and friable they may be put in at a depth of from 5 to 6 inches, and in heavy land about 4 inches. Early potatoes should be planted at the shallower depth in order that they may get the full benefit of the sun's warmth.

The standard distance at which early varieties should be planted from each other is 8 to 12 inches apart in the rows and 20 to 24 inches between the rows. Mid-season and late varieties may be given 12 to 18 inches between the sets, and 24 to 30 inches between the rows.

General Cultivation during Growth.

It should be the aim of all growers to keep the land in which potatoes are growing frequently stirred during the period of growth, and all weeds should be kept down. The plants should be earthed up the first time when they are about 6 in. high, and a second time about three weeks later.

This drawing up of the soil to the plants promotes the formation of tubers, prevents the soil from getting too wet, and supports the haulm. If the soil has a tendency to get wet the ridges should be made as steep as possible, but the covering of soil should only be sufficiently deep to prevent the potatoes as they form from being exposed to the air and light. Small growers when lifting a few potatoes at a time should lift alternate plants or pairs of plants, or alternate rows, as may be convenient, in preference to working straight through the plot. By doing so the ground

is stirred and the plants that are left often bear a larger crop in consequence, while an additional advantage is that cauliflowers, cabbages, broccoli, Brussels sprouts, kale, &c., may at once be planted in the vacant spaces or opposite them in the furrows between the rows.

Varieties to Plant.

The selection of the best variety to plant is a matter of great importance, and growers must to a certain extent be guided by the experience of the district in which they live. Some varieties of potatoes which do well in one district prove disappointing in another, and nothing but actual testing will prove whether any new variety is worth planting locally.

The following is a list of reliable varieties which can be purchased from most dealers. Preference should be given in all cases to those which can be guaranteed as having been grown either in a northern climate, or for not more than one year in the south of England.

EARLIEST VARIETIES :—

Epicure, Early Puritan.—These are round white-fleshed sorts. Epicure is the better cropper.

Duke of York or Midlothian Early, May Queen, Sharpe's Express, Ninety-fold.—All are kidney-shaped. The first variety has yellow flesh and is one of the earliest to ripen. The others are white-fleshed varieties. May Queen is very early, and is popular in the south-west. The two last named are both very good croppers.

SECOND EARLIES :—

Eclipse.—Often classed as a first early. Good quality, and well suited for the general purposes of a small grower who does not wish to plant more than one kind. *Royal Kidney.*—Useful on heavy soils. Not liable to ordinary potato disease. *British Queen.*—A strong-growing potato of first-rate quality, but very liable to ordinary potato disease. Should not be planted in low-lying, damp situations. *Conquest.*—Suitable for land affected with Wart Disease, as it is resistant. *Windsor Castle.*—Much grown by allotment holders as an exhibition sort. *Great Scot.*—Good cropper. Resistant to Wart Disease.

LATE VARIETIES :—

Sutton's Abundance.—Good quality, well suited for garden cultivation, but rather liable to ordinary potato disease in wet

seasons. *Evergood.*—A useful variety for heavy land. *King Edward VII.*—Much grown in the east and south of England and one of the best late sorts. *Up-to-date.*—A vigorous grower widely cultivated, of which there are many strains (*e.g. Dalhousie, Factor*). A change of seed from the north is specially desirable in this case. *President.*—A good late variety suitable for allotments. *Arran Chief.*—A particularly vigorous variety of good cooking quality. *Golden Wonder.*—Requires good loamy soil, liberal manuring, and should be sprouted before planting ; does not contract Wart Disease.

Allotment holders and others who must grow potatoes on inferior clay soils under conditions not well suited for the crop, should select vigorous varieties, such as *Epicure, Royal Kidney, Evergood, King Edward VII., Up-to-date,* and *Arran Chief.*

Occupiers of premises declared to be infected under the Wart Disease of Potatoes Order of 1914, or situated in an area declared infected under the Wart Disease of Potatoes (Infected Areas) Order of 1914, must make application for a licence to plant potatoes before any potatoes are planted. Those varieties mentioned above which are susceptible to Wart Disease will not be authorised for planting on such premises, and application should be made to the Board for a list of immune varieties. The penalty for any contravention of the above-named Orders is Ten Pounds.

Whitehall Place, London, S.W.,
February, 1915.
Revised, February, 1917

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 297.*

BOARD OF AGRICULTURE AND FISHERIES.

Seed Testing.

It is upwards of forty years since seed testing† was established in Denmark and Saxony, and the importance of a proper examination of seeds, to ascertain whether they are suitable for sowing, is now generally recognised.

The following facts will indicate to farmers that it is worth their while to take the greatest care to ensure that the seeds they sow are good.

1. The amount spent on the principal farm seeds in this country (cereals, pulse, roots, rape, vetches, lucerne, sainfoin, clovers, and grasses) reaches millions of pounds sterling annually, the value of the seeds named sown in Great Britain in 1914 being estimated at nearly £7,000,000. In view of the present scarcity, and increased cost of seeds, it is more than ever necessary to exercise care in purchasing.

2. The yield of the crop may be greatly influenced by the quality of the seed sown.

3. Seeds are perhaps more variable in quality than any other goods the farmer has to purchase. The *Purity* of seed varies according to the manner of growth and the methods of harvesting and cleaning. The *Germinating Power* varies with the weather during the period of growth—especially at the time of harvesting—as well as with the mode of harvesting and storing. Old or dead seeds are sometimes mixed with fresh seed of the same species in order to increase profits.

4. It has been estimated that about 16½ million pounds sterling per annum is lost by farmers in Great Britain in growing (and getting rid of) weeds. Large numbers of weed seeds are introduced to the land as impurities in agriculture seed, and seed testing, which reveals the presence of the impurities is, therefore, an important factor in keeping weeds under control. This point is especially worthy of consideration now that farmers are finding it increasingly difficult to spare labour for weeding.

"*Real Value*" *of Seed.*

In order to avoid wasting money on weeds and dead seeds the "real value" of seeds should be ascertained. The real value‡ is arrived at by multiplying the percentage of growing seeds by the percentage of pure seeds and dividing by 100. With real value is intimately associated the quantity and kind of *Impurities*, which may render necessary the refusal of a sample even if the real value considered alone is satisfactory.

The following example illustrates the importance of paying for seeds on the basis of real value and comparative freedom from harmful impurities.

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* Previously issued as Special Leaflet No. 24.

† Various terms used in this leaflet are briefly explained at p. 6, and might with advantage be read at the outset.

‡ *See* p. 7.

Five samples of red clover seed were tested and showed the purity and germinating capacity stated below; hence their real values were as shown in the third column :—

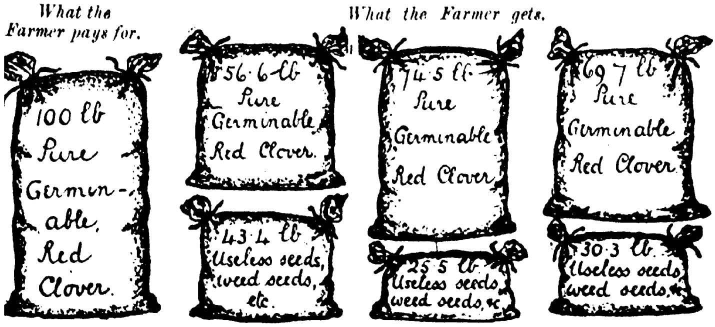
No.	Purity (per cent.).	Germinating capacity (per cent.).	Real Value (per cent.).
1	82	69	56·6
2	80	72	57·6
3	90	62	55·8
4	92	81	74·5
5	82	85	69·7

A buyer who pays a fair price should *expect* to get a red clover of 98 per cent. purity and 95 to 98 per cent. germination, or a real value of 93·1 to 96·0 per cent. If, however, a real value of only 90 per cent. were expected, the loss between a sample of that value and the five samples referred to (presuming the prices are the same), would be as follows :—

No.	Loss in lb. per cent.	*i.e.* Loss on £5 worth of seed. £	*s.*	*d.*
1	90-56·6 = 33·4 lb.	1	13	5
2	90-57·6 = 32·4 "	1	12	5
3	90-55·8 = 34·2 "	1	14	2
4	90-74·5 = 15·5 "	0	15	6
5	90-69·7 = 20·3 "	1	0	3½

The loss caused by the inclusion of useless seeds, weed seeds and rubbish in Nos. 1, 4 and 5 of these clover samples on purchasing 100 lb. is graphically shown in the figure below. Further heavy loss would be caused by the weed seeds after sowing.

What the Farmer pays for. *What the Farmer gets.*



Sample No. 1. *Sample No.* 4. *Sample No.* 5.

Figure showing the losses in purchasing samples 1, 4, and 5 of seeds referred to above.

While good seed is easily procurable in this country the Board have evidence that there is much bad seed on sale. Samples taken during the three years 1912-14 to test the quality of the seed being sown in certain districts gave the following poor results:—

1912.

Samples sold as	Remarks.
56 English or Welsh Red Clover.	Average real value, 67·34 per cent. 30 samples contained dodder—20 in considerable quantity; 8 contained both Chilian and European dodder.
31 White Dutch Clover ...	Average real value, 50·6 per cent. 18 samples contained dodder.
29 Alsike	Average real value, 54·15 per cent. 19 samples contained dodder.
10 Sainfoin	Average purity, over 99 per cent.; average real value, 45·8 per cent.
37 Italian Rye-grass ...	Average real value, 79·24 per cent.
23 Perennial Rye-grass ...	Average real value 72·5 per cent.

1913.

42 English or Welsh Red Clover.	Average real value, 58·1 per cent. 28 samples contained dodder, viz., 12 European dodder, 12 both European and Chilian dodders, and 4 Chilian dodder.
30 White Dutch Clover ...	Average real value, 61·3 per cent. 8 samples contained dodder.
21 Alsike	Average real value, 58 per cent. 8 samples contained European dodder.
29 Sainfoin	Average purity, 98·5 per cent.; average real value, 35·5 per cent.
24 Italian Rye-grass ...	Average real value, 72·5 per cent.
23 Perennial Rye-grass ...	Average real value, 71·8 per cent.

1914.

30 English Red Clover ...	Average real value, 55·9 per cent. About ½ contained dodder.
43 White Dutch Clover ...	Average real value, 56·9 per cent. About ½ contained dodder.
25 Alsike	Average real value, 62·48 per cent. About ¼ contained dodder.
24 English Cow-grass ...	Average real value, 72·67 per cent.
20 Cocksfoot	Average real value, 63·13 per cent.
13 Meadow Foxtail ...	Average real value, 51·37 per cent.

The Cost of Weeds.

The seeds of common weeds vary so much in size that a mere statement of the percentage present conveys no real

idea of the damage that they may do. Attention is therefore called to the following figures which show the approximate numbers of some common weed seeds which are contained in $\frac{1}{100}$th part of 1 lb., and which might accordingly be found in 1 lb. of any seed containing 1 per cent. of any one of them as an impurity.

Species of Weed Seed.	No. of Seeds
Creeping Buttercup (*Ranunculus repens*, L.)	2,900
Red Field Poppy (*Papaver Rhœas*, L.)	40,000
Charlock (*Brassica Sinapis*, Vis.)	1,980
Shepherd's Purse (*Capsella Bursa-pastoris*, Moench.)	45,000
Field Pansy (*Viola tricolor*, L.)	6,700
White Campion (*Lychnis vespertina*, Sibth.)	8,500
Chickweed (*Stellaria media*, Cyrill)	12,000
Mouse-ear Chickweed (*Cerastium vulgatum*, L.)	36,000
Dove's-foot Geranium (*Geranium molle*, L.)	4,500
Cut-leaved Geranium (*G. dissectum*, L.)	1,900
Wild Carrot (*Daucus Carota*, L.)	4,400
Field Madder (*Sherardia arvensis*, L.)	2,500
Ox-eyed Daisy (*Chrysanthemum Leucanthemum*, L.)	11,000
Stinking Mayweed (*Anthemis Cotula*, L.)	12,800
Scentless Mayweed (*Matricaria inodora*, L.)	11,600
Wild Chamomile (*Matricaria Chamomilla*, L.)	79,000
Groundsel (*Senecio vulgaris*, L.)	21,800
European Clover Dodder (*Cuscuta Trifolii*, Bab.)	18,000
Chilian Dodder (*Cuscuta racemosa*, Mart.)	7,300
Self-heal (*Prunella vulgaris*, L.)	6,800
Rib-grass (*Plantago lanceolata*, L.)	3,030
Hoary Plantain (*P. media*, L.)	8,500
Goosefoot or Fat-hen (*Chenopodium album*, L.)	6,600
Curled Dock (*Rumex crispus*, L.)	3,200
Sheep's Sorrel (*R. Acetosella*, L.)	10,500
Yorkshire Fog (*Holcus lanatus*, L.) (in glumes)	8,900
Yorkshire Fog (*Holcus lanatus*, L.) (without glumes)	12,700
Wavy Hairgrass (*Aira flexuosa*, L.)	8,400
Tufted Hairgrass (*A. cæspitosa*, L.)	25,500

Thus, if a red clover sample contains 1 per cent. by weight of European clover dodder, each pound of the "red clover" seed will contain 18,000 seeds of dodder: if 16 lb. of red clover were sown per acre, this would mean 60 dodder seeds per square yard over the whole area sown. Similarly, 1 per cent. by weight of rib-grass seeds in 16 lb. of red clover would represent 10 seeds per square yard over the whole area.

It should, further, be remembered when purchasing grass or clover seeds which vary very much in size, that 1 per cent. of a certain weed may mean a much greater number of weed seeds as compared with good seed in some cases than others. This is shown in the following table, where a large clover seed is contrasted with a small one, and a heavy grass seed is contrasted with a light grass seed.

One per cent. by weight of the following weed seeds	Represents the Percentages by number given below.			
	In Red Clover.	In Alsike or White Clover.	In Rye Grasses.	In Meadow Foxtail.
Red Field Poppy	17·3	5·5	—	—
Shepherd's Purse	19·8	6·2	—	—
Chickweed	5·2	1·6	—	—
Ox-eye Daisy	4·8	1·5	—	—
Stinking Mayweed	5·5	1·7	—	—
Scentless Mayweed	5·0	1·6	—	—
European Clover Dodder	7·6	2·4	—	—
Self-heal	2·9	0·9	—	—
Hoary Plantain	3·7	1·2	—	—
Goosefoot or Fat-hen	2·8	0·9	—	—
Sheep's Sorrel	4·6	1·5	4·4	2·2
Creeping Buttercup	—	—	1·2	0·6
Yorkshire Fog (in glumes) ...	—	—	3·6	1·8
Yorkshire Fog (without glumes)	—	—	5·1	2·5

Thus, if one-hundredth part of the weight of a purchaser's red clover seed is really poppy seed, 17 per cent., or 1 in 6, of the seeds sown will be poppy, so that if the clover seed costs 9*d.* per lb. about 1½*d.* goes in providing a "change of seed" of the common red poppy!

Characteristics of Good Seed.

A good sample of seed should fulfil several conditions, and farmers should be careful to purchase on this basis:—

1. It should be true to name, or of the correct species.

2. It should be as pure, or free from impurities, as modern knowledge and machinery can make it.

3. It should be heavy, dry, fresh and vigorous, with a high power of germination or growth. In clovers the percentage of "hard seeds" should be low.

4. It should be of stated origin. The country or locality in which it was grown should be specified.

5. It should be free from injurious insects and fungi.

How Farmers may Purchase Good Seeds.

The farmer should take the following precautions to guard against sowing bad seed or seed of low quality.

1. The seed merchant should be asked for a guarantee (*a*) as to purity and germinating capacity, and (*b*) as to the weed seeds present, making the latter point an important part of the contract to purchase.

2. The farmer should purchase his seeds subject to the right of return if, on analysis by a recognised agricultural

botanist, the seeds do no come up to the guaranteed standard.

3. The farmer should be prepared to pay a fair price for the seed he requires: if he insists on a low price he is practically insisting on low quality.

4. Farmers should submit samples of the seeds they purchase, under guarantee and subject to analysis, to a competent agricultural botanist at one of the Agricultural Colleges or to a County Agricultural Organiser,* and only accept the bulk on his recommendation to do so. Instructions as to sampling, labelling, &c., should first be asked for from the expert concerned.

5. Farmers should purchase the grasses and clovers they require separately and mix them themselves.

6. Farmers in the same district should co-operate, both for the purchase and examination of the seeds they require.

7. Finally, in sowing seeds of their own harvesting—cereals or other seeds—farmers should be careful to see that the seeds are thoroughly cleaned. *Sweepings from the hay-loft, from hay-carts and similar sources should on no account be used for pastures.*

What a Seed Analysis should show.

A seed analysis or examination should contain a statement as to the *Purity*, the *Germinating Capacity*, and the *amount* and *nature* of the *Impurities*—particularly noting *Weed Seeds*. The *Speed or Energy of Germination* should also be indicated, since (other things being equal) if a sample germinates 90 per cent. in five days it is far better than a sample which germinates 90 per cent. in ten days. Though the purity and germination may be apparently satisfactory it may be necessary to refuse the seed solely on account of the presence of weed seeds, which are always useless and may, if sown, cause continual difficulty and loss.

Explanation of Terms used in connection with Seed Analyses.

Species.—The seed should be of the kind or *species* ordered, *i.e.*, "true to name." The species may in general be readily determined, but variety can usually only be determined by growing the crop from the seed.

Origin of Seed.—This is a statement as to the source of the seed—the district or country in which it was grown—*e.g.*, *English* red clover, *French* lucerne, *Provence* lucerne, *Chilian* red clover, *Dutch* dogstail, *New Zealand* cocksfoot, *Danish* hard fescue, *American* timothy, *Canadian* alsike.

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* For full list of addresses see Leaflet No. 279, *Technical Advice for Farmers.*

Weight.—The weight of seeds is important, the heaviest samples of a species usually being the best; hence the weight per 1,000 seeds is often determined.

Germinating Capacity.—This means the number of seeds per hundred of the pure seeds true to name which will sprout under favourable conditions. *Energy or Speed of Germination* is the percentage of the pure seeds which will sprout in a given time.

Purity.—This term indicates the amount or percentage of seed true to the species in question present in a sample after all other seeds (including weed seeds), chaff, dust, stones, &c., have been removed. All the latter are included in the *Impurity*.

Real Value.—The "real value" of a sample of seeds is the percentage of the *pure* seeds present which will germinate; it is obtained by multiplying the purity by the germinating capacity and dividing by 100. Thus if the purity is 95 per cent., and the germinating capacity is 90 per cent., the true value is $\frac{95 \times 90}{100} = 85 \cdot 5$ per cent. It should be noted, however, that the value must also depend on the nature of the impurities which are present.

Hard Seeds.—Clover and lucerne seeds may contain a proportion of seeds which do not germinate quickly because the seed-coat does not readily permit the entrance of water. These seeds are called "hard seeds." They may germinate after lying a considerable time in the soil.

Moisture Content.—The degree of dryness of seeds is important as it indicates whether they have been well harvested and stored. The amount of moisture present is often determined in seed control work.

The following articles on seed testing have been published in the *Journal of the Board of Agriculture** in recent years:—

The Study of Agricultural Seeds.—W. Borlase, October, 1912, p. 529.

The Control of Agricultural Seeds in Switzerland.—J. Long, December, 1912, p. 726.

Seed Analyses: Their Interpretation and Use.—S. F. Armstrong, January, 1913, p. 827.

Seed Testing.—W. M. Findlay, July, 1913, p. 301.

The Condition of the Seed Trade in Mid-Wales.—Aug., 1914, p. 426.

Seed Control Stations on the Continent.—*Journal Supplement*, August, 1914.

* Price 4*d*. per copy, post free, from The Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

The Improvement in the Standard of Quality of Agricultural Seed in Ireland.—October, 1914, p. 585.
Seed Testing for Farmers.—March, 1915, p. 1098.
Report on an Inquiry into the Quality of Farm Seeds in 1912-14.—Prof. R. H. Biffen, Feb., 1916, p. 1041.
Seed Testing, and the Need for Destroying Weeds.—Feb., 1916, p. 1055.

Whitehall Place, London, S.W.,
April, 1915.
Revised, October, 1916.

Leaflet No. 298.

BOARD OF AGRICULTURE AND FISHERIES.

Pig-keeping for Cottagers and Small Holders.

It is probable that no branch of animal husbandry can be more usefully extended at the present time than that of pig-keeping.

Few animals are capable of giving a quicker return for foods consumed and none is better adapted for turning into wholesome meat much material that is usually regarded as of little or no value. While pig-keeping, generally, might well receive increased attention, it is intended in this leaflet to deal with the subject mainly from the standpoint of the cottager and rural householder whose facilities for keeping pigs are relatively limited. In so far as the same method of pig-keeping is applicable, however, the suggestions made may also prove useful to the small holder with more land and other facilities at his disposal.

It is usually well within the means of most people who possess a fair-sized garden, and who can conform with the regulations of the local sanitary authority, to keep at least one pig. The garden and kitchen will supply a considerable proportion of the animal's food. Should circumstances, however, necessitate the purchase of the whole of the food material, pig-keeping will not as a rule be very profitable.

Type of Pig.

One of the first points to consider is the type of pig which should be kept.

Before selecting a pig the small pig keeper should first decide whether he intends to breed from it or to feed it on as a store or a fat pig and in the latter case, whether it is to be converted into pork or bacon. Whichever may be his intention he would be well advised to select the breed or type of pig that is the most popular in his district for the purpose for which he requires it; the reason being that should he wish to sell he will probably have to rely on a local buyer.

There are many breeds and crosses to choose from, the Large White Yorkshire or Large Black breeds will usually be found the most suitable for bacon purposes but for making into pork, Berkshires, Middle Whites, Lincolnshire Curly-Coated and Gloucestershire Old Spots, are preferred by many breeders, while others maintain that a cross-bred animal is the most profitable for converting into either bacon or pork. Whatever breed or cross is selected it is advisable to choose

the offspring of a well-bred dam of good conformation. It is also very important that the sire should be pure-bred and that the sire and dam are not too closely related.

It is advisable to start pig-keeping with a newly-weaned pig, about 8 weeks old, care being taken to secure as good a specimen as possible. An extra shilling or two spent on a good pig will be amply repaid; the temptation to be satisfied with an unthrifty weakling, merely because it is to be had for less money, should be stoutly resisted. At the same time the buyer should not devote too much attention to fancy points. Above all he must have an animal with a vigorous constitution—a greedy, lusty fellow, active on his legs, lengthy and round in shape, with a clean and pliable skin covered with a fine coat of soft, glossy hair.

Feeding.

For several weeks after weaning the pig should receive its food in a moderately sloppy condition, slightly warm if the weather is cold. The food should be easily digestible and may consist of potatoes, turnips and other vegetables, together with table scraps and grease from the kitchen, and a little middlings or sharps. The roots and vegetable matter should be boiled together and afterwards well mashed and mixed, the meal being incorporated at the same time. Sufficient water should be added, or preferably a little skim milk if it is available, to give the whole the consistency of gruel. A newly-weaned pig will usually require about 2 lb. of food per day, irrespective of added water, and, in the absence of milk, half the food should consist of middlings or similar material.

The young pig should be fed regularly three times a day, the food being gradually increased, as much being given at each meal as it will readily clear up. Caution is necessary in the use of kitchen waste, as such material frequently contains salt and soda in such quantities as to be highly prejudicial to young pigs. Dried blood, meat meal, fish meal and linseed cake meal all have a high content of easily digestible flesh-forming material, and are therefore suitable for feeding to young pigs, a little at a time, in the absence of dairy waste. As the pig is naturally a grazing animal it is important that succulent vegetable food should form part of its food at all seasons of the year.

In the summer succulent green food is generally plentiful enough. Young grass from the wayside, weeds from the garden, and similar material, will all be picked over by a young growing pig to its advantage. Tender young clover and lucerne are excellent green foods for pigs. Lucerne especially is valuable in that it is available early and late in

the year, several cuts being obtainable annually. A small patch of ground could well be spared for this highly nutritious forage plant.

Rape, vetches, and rye, or a mixture of these, if sown in small plots, which would otherwise be left bare throughout the winter, will supply highly nutritious green food at times when such material is scarce. For the supply of the necessary succulent food in the dead of winter recourse must be had to potatoes, turnips, mangolds, sugar beet, artichokes, &c. Of these, potatoes and sugar beets are the most valuable, 4 lb. of either being considered equivalent to 1 lb. of cereal meal.

For the first month or two the pig should be allowed a moderate amount of exercise. An occasional run outside its sty will tend to promote a healthy appetite and to encourage growth.

When the pig reaches about 100 lb. in live weight this form of exercise should be considerably curtailed, and feeding should be rather more forced. Wheat offals, accompanied by a little rice meal, maize meal, or barley meal, whichever is cheapest, may be given more freely, and the supply of the more bulky vegetable foods should be correspondingly reduced. There is no more suitable food for the final stages of fattening than maize, but sometimes other and cheaper foods can be substituted.

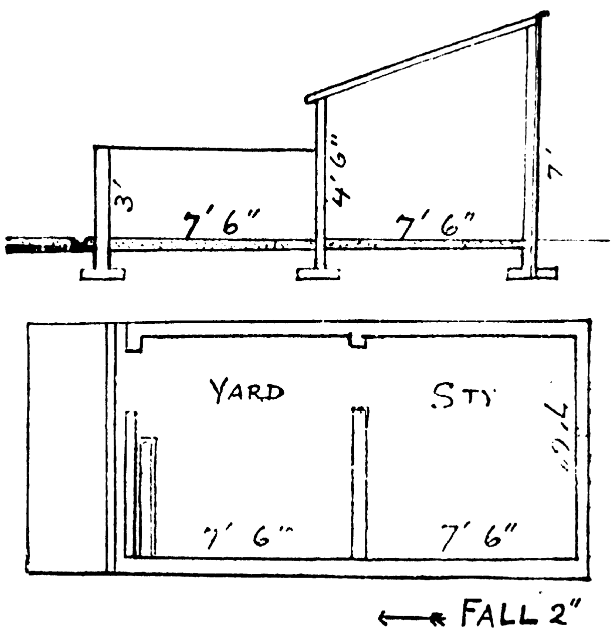
With pigs of the weight stated the possibility of utilising such materials as acorns, horse chestnuts, and beech mast should be considered. Acorns have long been recognised as a suitable food for pigs, and in many parts of the country they still form a regular portion of the pigs' diet during the autumn and winter. Their value as gathered has been put at from 1*s.* 6*d.* to 2*s.* a bushel, or about half the value of maize, which they resemble in composition, but 9*d.* to 1*s.* per bushel is commonly paid for collecting them. Before using, they should be spread out in thin layers to dry, as in the dry condition they are both more palatable and less astringent than in the fresh state. Their chief value for feeding lies in their high starch content and digestibility. They are best adapted for feeding along with the more laxative vegetable foods and foods rich in flesh-forming material, such as the wheat offals and maize gluten feed. From 1 to 2 lb. daily per pig, may be fed in this way.

Horse chestnuts dried, husked and ground constitute an even richer feeding stuff than acorns. On the basis of analysis 1 lb. of chestnut meal is equal to 1 lb. 1 oz. of barley meal, or 1 lb. 4 oz. of oats, or 1 lb. 8 oz. of bran. Chestnut meal, however, is bitter to the taste and stock will not readily eat it if unaccompanied by other more palatable

foods. Up to 1¼ lb. per head, per day, has been fed to pigs with good results.

Little is known as to the food value of beech mast. Only the kernel, which is extremely rich in nitrogenous substances and in fat, should be fed. In small quantities accompanied by starchy foods it may safely form part of a pig's daily ration.

It should be remembered that the pig is an omnivorous eater and requires variety in its food. Care should, however, be taken to avoid sudden changes in diet. Another important point to remember, especially with pigs confined to



A Simple Pigsty for two Store Pigs: Section above, ground plan below

sties, is the necessity of supplying a regular allowance of gritty material, preferably small coal or wood ashes, or, failing these, earthy turf. Such material has a valuable tonic effect.

If carefully fed from the start a pig should weigh from 170 lb. to 180 lb. live weight at from 5 to 6 months old, when it should be ready for killing. The amount of food required at this stage will be from 5 to 6 lb. of meals or

their equivalent daily, and the dressed carcass should weigh from 130 lb. to 140 lb. Beyond this point the rate of increase gradually slackens, while the amount of food required to produce 1 lb. of increase becomes greater. Fat bacon and fat pork are more useful as food than lean, especially in winter, and the cottager who fattens only one pig for his own use would do well to bear this in mind.

Housing.

In respect of housing no elaborate structure is necessary, the main essentials being comfortable and clean conditions. A dry bed, combined with suitable ventilation and the absence of draughts, promotes the general health of the animal, prevents chills and rheumatism, and minimises risk of disease.

The foundation must be dry and, if conditions permit, the piggery should face the south. Access to a small paddock is a distinct advantage ; where, however, this is impossible, the following arrangement, providing sufficient accommodation for two store pigs, should answer the purpose of the cottager or small holder.

Openings in the walls and roof through which the passage of air may be easily regulated should be provided in order that the temperature may be kept as even as possible throughout the year. A close stuffy atmosphere destroys the appetite and is as harmful as a cold sty. Provision for suitable lighting may be made either in the wall or in the roof. The walls will usually be built of brick, concrete or wood, or wood on a brick foundation, and the building may often conveniently take the form of a lean-to. It should be high enough to obviate all difficulty in cleaning out. For the roof slates, tiles or thatch may be used, or corrugated iron is suitable if the inside is lined with wood. A roof of wood, covered with thick tarred felt will also suffice to keep out cold and wet.

There is less choice in respect of the floor, which is the most important part of the sty. From a sanitary point of view concrete is the most suitable. This should be grooved to afford a foothold. Part of the floor, sufficient to provide bed accommodation for the pig, should be of wood or, at all events, it should be covered with a wooden platform, cement alone being too cold and liable to give rise to rheumatism. Hard bricks are more comfortable than cement and make a suitable floor. Earth or clay, however well beaten, is liable to get broken up and become puddled. The floor should slope gently to the front of the sty to help drainage. Surface drains are to be preferred, as they can

readily be kept clean. The drainage should not be wasted, but should pass into some convenient receptacle for use in the garden with the solid excrement.

Bedding.

In the absence of straw, dried bracken, grass and leaves make thoroughly efficient bedding. Every effort should be made to provide an abundant supply, especially in cold weather, when the pig prefers to curl up in bed and is content with the minimum of exercise. When it is remembered that food is more expensive in winter than in summer, and that it takes more food in winter to produce 1 lb. of pork, the supreme importance of comfort during the coldest season of the year is apparent.

To be successful in pig-keeping the beginner must bear in mind local circumstances and conditions, which are best known to himself; he must study the individuality of the animal and the properties of the feeding material at his disposal, and direct his energies to securing the maximum production of pork at the minimum of expense.

Where circumstances permit, breeding combined with feeding, or even breeding alone, will be found preferable to feeding alone. This further aspect of the subject is dealt with at length in Leaflet No. 9 (*Pig Keeping for Small Holders*), issued by the Board of Agriculture for Scotland. Copies of this leaflet may be obtained on application.

Rations.

A few examples of basal rations are appended. In each case Ration 1 represents a mixture of feeding stuffs in common use, and the alternative (Ration 2) shows how by using other feeding stuffs the diet may be cheapened. The prices were those ruling in London in November 1916.

In addition to the foods specified the pigs will require moderate allowances of waste potatoes or other roots and such green forage as may be available; in the winter months these should be boiled and mashed and the meals incorporated before feeding. About 4 lb. of waste potatoes or 8 lb. of swedes are equivalent to 1 lb. of mixed cereal meals for pig-feeding. Swedes should be used in the proportion of 4 lb. of swedes to 1 lb. of meal. For pigs up to 3 months old, at least, a little skim or separated milk is most beneficial, and when procurable at from one-sixth of the cost per lb. of mixed meals, it will invariably prove economical. (1 gallon of milk weighs 10 lb. approximately.)

For Pigs of 25–60 *lb. Live Weight.*

Ration 1.		*Ration* 2.	
⅔ lb. Middlings	1¾*d.*	⅔ lb. Maize Meal	1½*d.*
⅓ " Barley Meal		⅓ " Coconut Cake or Linseed Cake Meal ...	

For Pigs of 60–100 *lb. Live Weight.*

Ration 1.		*Ration* 2.	
1 lb Sharps	3½*d.*	¾ lb. Maize	3*d.*
1 „ Barley Meal		¾ „ Dried Grains	
		½ „ Palm-nut Cake, Coconut Cake or Bean Meal.	

For Pigs of 100–180 *lb. Live Weight.*

Ration 1.		*Ration* 2.	
1 lb. Sharps	5*d.*	1 lb. Maize	4½*d.*
1 „ Barley Meal		1 „ Dried Grains	
1 „ Maize Meal		1 „ Palm-nut Cake, Coconut Cake or Bean Meal.	

In an experiment* with pigs recently conducted in Yorkshire, it was shown that palm kernel cake and extracted palm kernel meal can be safely used as food for pigs in proportions ranging up to about one-third of the total ration. Finely ground palm kernel cake would appear to be about equal in feeding value to fine sharps (thirds) and appreciably superior to extracted palm kernel meal. At the present time these palm kernel feeding stuffs are considerably cheaper than the finer wheat offals.

* *Journal of the Board of Agriculture*, December, 1916. "Palm Kernel Cake and Meal as Food for Pigs."

Whitehall Place, London, S.W.,
October, 1914.
Revised, December, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

Leaflet No. 299.*

BOARD OF AGRICULTURE AND FISHERIES.

Harvesting and Storing of Garden Vegetables.

Allotment holders and occupiers of small gardens seldom grow sufficient vegetables to last all the winter, and in many cases do not think it necessary to make arrangements for storing their crops. The produce, however, of even a small garden, if it is suitably stored, can be made to last much longer, while the allotment or garden can be more profitably cultivated if each crop is lifted at the proper time, and the land is at once dug over in preparation for the next crop. Constant digging, hoeing and turning over the soil tends also to keep down insect and fungus pests, and to secure a better yield for each successive crop.

Harvesting the Crop.

Nearly all vegetable crops should be harvested as soon as they are ripe, as delay favours the development of disease. In most cases the proper time is obvious from the appearance of the plant. Thus *potatoes* should be lifted when the haulm begins to die; *artichokes* when the leaves begin to wither; *onions* when the bulbs are sufficiently large, the leaf-tips turn brown, and the leaves appear "slack" (the necks should be bent over to the soil a few days before the onions are lifted, and the skins should be allowed to die in order to make the bulbs round); *cauliflowers* should be cut before the "flower" loses its white curdy appearance; *carrots* should be lifted before the autumn frosts begin and when the older leaves show signs of withering; *broccoli* in the Midlands and the north of England (it is unnecessary in the south of England) should be laid over facing north on the approach of winter, to prevent damage to the colour of the "flower," and to enable the crop to resist a hard winter so that they may be cut in good condition in early spring; *celery* is ready for lifting as soon as the earthed-up stems are sufficiently blanched; and *parsnips* may be left in the ground and be raised when required, even after the tops have died down.

Methods of Storage.

Potatoes.—It is not advisable to attempt to store early potatoes for any length of time. After being lifted they should be kept in clean sacks, hampers, or covered boxes and be utilised as required. Diseased potatoes should at once be

* Previously issued as Special Leaflet No. 15.

picked out and burnt, and should on no account be left on the ground or be thrown on the manure heap. Further, they should not be fed to pigs or other animals, unless they have first been well boiled.

The sound potatoes should be sorted into three grades—the ware (cooking size), "seed" (small size) and chats (very small size). The last are generally given to pigs or poultry.

All potatoes of "seed" size which it is proposed should be kept for planting should be "boxed." Many growers do not box their late varieties owing to considerations of space, but small growers will find it will repay them to box all varieties before planting. Boxing consists in placing the potatoes in layers not exceeding two potatoes in depth in boxes or on shelves in a cool place where they will not be exposed to the frost, but will be exposed to light and air through the winter. Potatoes so treated turn somewhat green in the light, and the two or three short shoots which they put forth in the spring lead to a much better crop in the following season than may be expected from several weak shoots which usually result if seed potatoes are selected from pits in the spring and immediately planted.

If grown in sufficient quantity late potatoes may be stored in the open in a pit, pie, or clamp. This is formed by piling the potatoes in a solid triangular heap, or against a wall, and covering them over with straw and soil. They will usually keep well till the spring if the following precautions are observed:—

(1.) The clamp should be on a well drained site, and the potatoes should be piled on the ground, a shallow trench being dug round the clamp to supply soil to cover the potatoes, and to drain off the water after heavy rainfall.

(2.) The site should be as little as possible exposed to the sun, as it is essential that there should be no rise of temperature in the clamp. Potatoes may suitably be clamped against a north wall.

(3.) The potatoes should first be covered with straw to a depth of about six inches and then with about three inches of soil. The top of the ridge may safely be left covered only with straw for a time, but must be covered with soil before frosty weather sets in, when a ventilating hole should be left at the top of the ridge. Into the hole should be inserted a piece of tile piping, which in rainy weather may be closed with a bunch of hay or covered with a tile, but in fine weather, especially just after the clamp has been made, should be left open to allow the heated air to escape. If this is not done the potatoes may decay. About a month after the clamp

has been formed, but before severe frost sets in, the covering of earth should be increased to six inches or more in very cold districts. If frost reaches stored potatoes they will often decay as soon as a thaw sets in.

If the quantity grown is not sufficient to necessitate the making of a clamp, the potatoes may be stored in a sack or in boxes in a cool cellar or shed, but they should not be allowed to get too hot or be exposed to frost.

Artichokes may be stored in the same way as potatoes.

Beet may be lifted in October or November; the tops should be twisted off with the hand, and not cut with a knife, lest "bleeding" should follow. The best place to store beet is a shed where they will be protected from frost. They should be stacked in layers, with half an inch of clean sand, dry soil or sifted ashes between each layer of beet.

Carrots should be lifted in October, or during November, and the stems cut off close to the crown. They may then be stored in the same way as beet.

Parsnips.—The usual practice is to leave parsnips in the ground, even after the tops have died down, and only lift them as required. It is better, however, to lift them before the winter is over and store them in the same way as beet, if only for the reason that the ground may be dug over before the spring.

Beet, *Carrots* and *Parsnips* may also be pitted in the same way as potatoes if the storage accommodation is small and the quantity grown is large.

Cauliflower and Celery.—If it is desired to lift and store these vegetables on account of severe weather, or to cultivate the soil in preparation for the next crop, they may be lifted with as much soil as will cling to their roots, and be stacked upright in a cool shed to which light is admitted. The plants should be packed close together and the exposed side should be banked up with soil. In this way they will keep as long as in the open ground. The proper time to lift is about the end of October or during November for cauliflowers, and the middle of November for celery.

Onions should be lifted as soon as possible after ripening begins. They should first of all be dried on the surface of the ground, being turned occasionally till dry throughout. They may then be tied in straps or left on the floor of a dry shed. If tied in straps they can be hung from the roof or a beam.

Brussels Sprouts do not require storing, as they will stand the severest weather likely to be experienced in England.

Whitehall Place, London, S.W.,
November, 1914.
Revised, July, 1916.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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Leaflet No. 300.

BOARD OF AGRICULTURE AND FISHERIES.

The Breeding of Useful Pigeons.

Until recent years the supply of table pigeons for the English market was practically dependent upon imports from various continental countries, Italy being by far the largest producer of the so-called "Bordeaux" pigeons—long recognised as the best type of table bird. France and Belgium have also each contributed in no small measure to the nation's supply, but imports from the former country have steadily decreased, and those from Belgium are at present nil.

On the other hand, English breeders, with a view to the production of a market bird of all-round excellence, have given considerable attention during the last decade to the improvement of table pigeons, both by the importation of carefully selected stock, and by strict attention to mating. As a result there are now many British lofts devoted exclusively to the rearing of table pigeons on commercial lines, and satisfactory results are generally reported. The industry is still young, but the prospects are good, and in view of the steady and growing demand for first-class table "squabs," by which name the marketable birds are known, and of the fact that very little space is required to breed them successfully, the smallholder may keep with advantage a small flock of pigeons.

Young pigeons, when killed, can be disposed of either locally or in the various London markets, where the best type of "Bordeaux" birds are sold retail at prices often reaching 2*s.* 6*d.* per bird, and even more, when the season is at its height.

There is also a ready sale for young birds required for stock purposes. Many breeders rear birds exclusively to supply this demand, and realise remunerative prices for stock of the approved type.

In rearing pigeons for the table it is important to remember that the breeder should only keep very prolific birds, capable of producing large, fast-growing squabs, fine in bone and possessing a delicate, white skin.

The Best Breeds.

Many kinds of pigeons are reared for table purposes, including common Homers, but the two most suitable are the Carneau and the Mondain.

Of the two, the Carneau is perhaps the more prolific and somewhat hardier pigeon, though both are quick breeders and easily kept, even in exposed positions. They are now well established in this country, and readily procurable.

The *Carneau* is a large-sized pigeon, weighing, when adult, from 1½ to 2 lb. It is a native of Flanders, where for generations it has been bred almost exclusively for utility purposes, gaining a reputation second to none as a producer of the best class of table squabs In colour the birds are either red or yellow, mottled with white, but those most frequently met with in England are wholly red, no particular attention being paid by utility breeders to colour or markings. Small, undersized specimens are frequently offered for sale, but should be avoided, hens especially, as such birds are wanting in stamina and unlikely to produce robust stock.

The Carneau is a thick-set, compact pigeon, possessing a broad, meaty breast, and a pinky-white skin. It is somewhat short in the neck, and, unlike many of the large breeds, is not overburdened with great length of feather in the wings—a decided consideration in the loft, where freedom of action and absence of clumsiness are of great importance. The legs are pale red in colour and without feathering, and this, coupled with the fact that the Carneau is active in habit and light upon the wing, renders it an eminently attractive-looking and decidedly ornamental pigeon.

It is also tender with its young whilst in the nest, and an excellent breeder, usually rearing five or six pairs of squabs in the course of the season.

The *Mondain* closely resembles the Carneau in general characteristics, but it is larger and thicker in build, and is found in a great variety of colours, mostly interspersed with white; frequently, indeed, it is entirely white. In this breed the legs and feet are in many cases more or less heavily feathered, a feature which must be regarded as detrimental to utility properties, since the quills upon the feet and toes are liable to puncture the eggs during incubation.

In both the Carneau and the Mondain the head is dove-shaped, full in the forehead, and well rounded behind. The eyes, which vary considerably in colour, are somewhat prominent, and centrally placed. In specimens showing no white in the plumage the colour of the iris is usually yellow, and this is often the case with parti-coloured birds. White pigeons, however, possess dark eyes as a rule, though not invariably. The bill is moderately long and slender, the wattle at its base being small and smooth; eye-cere is fine in texture and flesh-coloured.

The formation of the breast is of the first importance; in a typical specimen it should be long, deep and prominent. Narrow or flat-breasted pigeons are practically useless for table purposes, and should be avoided, however good they may appear to be in other respects.

The back is wide at the shoulder, and tapers off towards the tail, which should be fairly short and narrow.

The wings are moderately long, powerful, and carried close to the body; when closed they ought to meet, but not cross, over the tail.

The legs are rather short, stoutly formed, and set-on sufficiently wide apart to give the bird a broad, "blocky" appearance, without being ungainly.

Of the two breeds described, the Mondain is the more docile in disposition. It is a very prolific pigeon, and though its young whilst in the nest are a little less hardy than those of the Carneau, they mature quite as rapidly, and grow into finer squabs.

Housing.

Pigeons kept for table purposes do best when confined in a loft or wired-in enclosure, and in arranging such a structure it is well to remember that as much air as possible must be allowed, and that protection from wind and rain is essential. A lean-to aviary measuring about 10 ft. by 4 ft., and 6 ft. high, will accommodate half a dozen pairs of birds; it should be covered in for about 4 ft. of its length to protect the nesting boxes or lockers, which may be fixed to the wall by means of brackets. The lockers employed with the greatest success are constructed of boards 1 ft. wide, cut into 4 ft. lengths, and placed one over the other about 18 in. apart (*see* illustration on page 4).

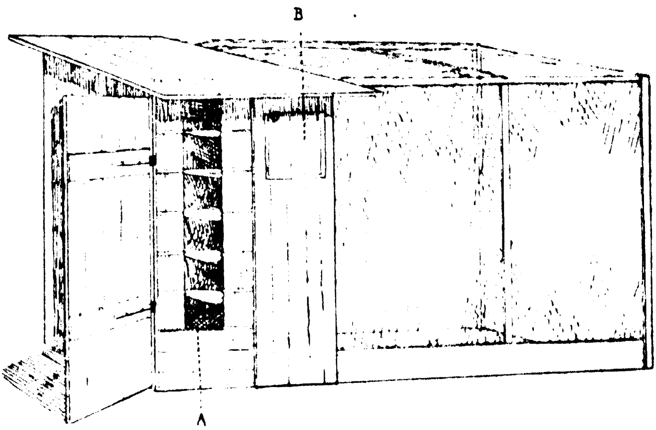
The shelves thus arranged are boarded in front, a space being left in the centre to allow for the alighting board, which should project about 6 in. in order to facilitate ingress and egress. Two ordinary earthenware nestpans, half filled with sawdust of medium grade, are placed in each locker.

This plan not only provides the necessary quiet for the pigeons whilst incubation is in progress, but it also permits of both pans being used at one time—an important consideration with quick-breeding pigeons, which generally have a second nest of eggs before the young of the first are old enough to care for themselves.

Pine sawdust, if procurable, is best for litter; it should be sprinkled thickly upon the floor of the nesting-boxes, also on the covered-in portion of the enclosure if the ground is hard and dry, but not otherwise. Its use materially assists

in keeping the premises clean and sweet, and if it be raked over and sifted regularly there is no difficulty in collecting the loft droppings which have been absorbed. The latter, it may be remarked, are employed in the process of tanning, and are readily saleable for that purpose. The refuse, however, must be stored in a dry place.

As regards the outer flight, it is desirable, though not essential, that this also should be protected from rain, the main point being to ensure a hard, dry, floor, which can be kept clean. Wood and galvanised iron are equally useful for roofing purposes.



A.—LOCKERS. B.—WINDOW.

Perching accommodation may be arranged according to requirements and the space at command. Flat perches, about 1 in. wide, are preferable, as they are easily scraped down.

Breeding.

The breeding season proper commences about the first week in February, and continues until the end of September. Some pigeon-keepers advocate winter breeding; but it is likely to prove unprofitable unless relays of birds can be employed for the purpose, and warm quarters—artificially lighted—are available.

Actually mated pairs only should be admitted to the loft, all other birds, whether cocks or hens, being a distinct danger to general harmony.

Previous to mating, the sexes should be kept apart, as much fresh air and exercise as possible being allowed them, with a view to encouraging hard condition. A small quantity of hemp seed, added to the food, is useful at this time; barley also is to be recommended.

Only birds that are perfectly healthy should be used for breeding, and on no account must closely related pigeons be mated together.

The best results are obtained by mating hens two or three years old with young cocks, or *vice versâ;* pigeons under the age of twelve months should never be allowed to breed together if robust offspring are desired.

When a selection of the breeding stock has been made, the intended pairs may be shut up together in the nesting boxes above described; this can easily be accomplished by fastening a small wire frame across the aperture of the locker. Here they may remain until nesting operations have commenced, after which the birds may be liberated for an hour or two each day until they have become accustomed to their surroundings, by which time complete liberty may be allowed.

Two eggs only are laid, and the period of incubation is nineteen days.

The young pigeons are practically naked when first hatched, except for a scant covering of silky down, which gradually gives place to feathers as growth proceeds. The squabs, being entirely dependent upon their parent birds for their food supply, require no special attention at the hands of the owner, who should be careful to remember that it is inadvisable to interfere with them for the first week or ten days, or the old pigeons may become restive and trample upon their offspring. Such precautions, however, need not be observed when the young are old enough to be left unbrooded by the parent birds; it is then indeed an advantage to remove them from the nestpan and place them on the floor of the locker, where the old pigeons will continue to feed them. The nestpans should be dressed with paraffin both inside and out, during hot weather, as a preventative against red-mite.

Foods and Feeding.

The food given to table pigeons should be clean, dry, and thoroughly sound. It is false economy to feed pigeons on low-priced, apparently cheap grain, which is often shrivelled, tainted, or otherwise unsuitable. The following mixture is useful for general purposes:—Equal parts of wheat (red), either white or maple peas, dari, and, during the cold weather, crushed maize. To this may be added clipped

oats, waste bread (crumbled), and coarse biscuit-meal, all of which, though not given to fancy pigeons, are excellent food for utility birds.

Buckwheat, hempseed, barley, millet and chicken-rice may also be employed with advantage as a change. Such pulses as beans and tares are of great value as flesh-formers, and may be fed on occasion. As regards maize, experience has proved that, while it can be fed freely to pigeons enjoying their liberty, it has a tendency to create fat in the case of confined birds, and if used without discrimination will ultimately ruin the stock for breeding purposes. For this reason it should not be given in quantity, though it is distinctly beneficial during cold spells.

Feeding.—Pigeons should be fed twice daily, in the morning and evening. In order that the food may not be fouled, it is desirable to place it in a hopper or earthenware pan on the floor of the loft; an ordinary nestpan answers admirably for the purpose, as it is easily cleaned and washed. Should it be found impracticable to give an evening meal, sufficient food may be left in the hopper for the day's supply; with a little experience the quantity may be gauged to a nicety.

Storing Grain.—Grain should be stored in a cool, airy place, free from damp, and with as much surface exposed to the air as possible.

Shallow, open troughs are best suited for storage purposes, as the grain can then be stirred periodically and kept sweet and pure; it is also advisable to sift all grain previous to use in order to remove any dust or foreign matter. Grain, if stored in bulk, is apt to ferment in warm, damp weather, and may cause bowel trouble if fed to the pigeons in that condition.

Grit, &c.—Grit and lime are both essential to the health of the flock. Grit is necessary to promote digestion, and may consist of good, hard, flint grit, mixed with calcined (burnt) oyster-shell; while the lime may be given in the form of old mortar rubbish, which should be mixed with coarse sand and ordinary table salt, damped and allowed to dry off and cake. Vessels containing a supply of each of these materials should be placed in the loft, under cover, and be replenished from time to time.

Water.—For holding drinking-water there is nothing better than the ordinary earthenware fountain as manufactured specially for pigeons. It must be cleaned and refilled regularly, and should be stood in a cool place away from the sun's rays.

Pigeons are inordinate bathers, and must be supplied with a wide, shallow water-pan, of which they will make the

fullest use for cleansing and beautifying their plumage. A pan of galvanized iron, without any soldering, will be found most convenient; it should be provided every other day during the summer months, and twice a week in winter, care being taken to remove the vessel after use.

Preparing for Market.

Well-grown squabs are ready for killing when between four and five weeks old; after that they lose flesh and are no longer the succulent morsels it is the business of the breeder to produce.

If the squabs have been properly fed, no special preparation is required to fit them for the table, though it is customary in the trade to fatten imported birds by artificial means, probably because they become thin owing to the rough treatment to which they are subjected whilst travelling. Millet seed and tares are employed for this cramming process, which is carried out by experts; the amateur breeder will find the work too troublesome to be profitable.

At the age above mentioned, the weight of a Mondain squab should be from 1 to 1¼ lb., and that of a Carneau somewhat less.

Occasionally a weight of 2 lb. is reached by extra fine specimens, but for all practical purposes squabs weighing 1 lb. apiece, on an average, are sufficiently large, and likely to be better in quality than heavier birds.

There are two methods of killing, viz.:—By dislocating the neck, near the head, and by severing the jugular vein with a knife. The latter is most in vogue among breeders supplying the London and other big markets, but there seems no real reason why breaking the neck, as practised with poultry, should not be equally effective, seeing that, when properly performed, the operation is cleaner and completely drains the body of blood.

After killing, the bird should be plucked and hung up to cool. Care must be exercised in plucking not to tear the skin, or there will be disfigurement and subsequent loss in value.

Dressing next follows, and is easily performed by folding the wings behind the back, and tucking the legs backward under the thigh. There is no necessity to remove the intestines at this stage.

The appearance of the carcass can be greatly improved by placing it, breast downwards, on a shaping board similar to that used for poultry. If the birds are laid out in a row and the top board is well weighted, they will quickly assume the required flatness, after which they are ready for packing. Shallow boxes, constructed to hold either six or eight pigeons,

are used for this purpose; they should be lined with clean, white paper, crimped at the edges.

In some districts dealers prefer to buy live pigeons rather than those already dressed. Only birds, known as "squeakers," i.e., those which still utter the nestling note, are suitable for this market, a point the intending breeder will do well to bear in mind.

Whitehall Place, London, S.W.,
September, 1915.

Copies of this leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

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Figures in large type (e.g. **288**) *indicate the number of the Leaflet and those in small type (e.g.* 2) *the page of the Leaflet. Generic and specific names are given in italics.*